THE

AMERICAN NATURALIST.

Vol. VI.—APRIL, 1872.—No. 4.

THE USE OF AMPHIPLEURA PELLUCIDA AS A TEST-OBJECT FOR HIGH POWERS.

BY DR. J. J. WOODWARD, U. S. A.

Over a year ago (February 1, 1871) the Surgeon General of the United States Army published a brief memorandum prepared by me, on the *Amphipleura pellucida* and its markings. This memorandum was accompanied by two photographs exhibiting the striæ of the diatom, as seen with a power of about one thousand diameters. The paper was republished in the "American Journal of Science and Arts" (May, 1871), and in the "London Monthly Microscopical Journal" (July 1871).

Since preparing the memorandum referred to, I have had occasion to use the *Amphipleura pellucida* a number of times as one of the means of comparing the high power objectives of various makers, and having found it, within certain limits, well adapted to this purpose, have thought the following remarks on its use would not be without interest to working microscopists.

Specimens mounted by various English preparers may readily be obtained from any of the large dealers in microscopical preparations. I have compared such modern slides with some of the original ones mounted by Messrs. Sollitt and Harrison, which I owe to the courtesy of Mr. W. S. Sullivant of Columbus, Ohio, with the sample in the first century of Eulenstein, and with other slides from various sources. I find all very much alike, the striæ usually varying from ninety to one hundred to the $\frac{1}{1000}$ of an inch. In a few large frustules I have found coarser striæ than the above

Entered according to Act of Congress, in the year 1872, by the PEABODY ACADEMY OF SCIENCE, in the Office of the Librarian of Congress, at Washington.

but finer ones in none. For the best use of the test it is essential that the frustules should be clean and mounted dry,* on the under surface of a very thin cover (not thicker than $\frac{1}{200}$ of an inch). In some of my slides the frustules are mounted between two thin covers, adhering to the upper one but I am not sure that this arrangement offers any decided advantages.

The first step in the practical use of this test, after obtaining a properly mounted specimen, is to select a frustule, to count the number of its striæ to the thousandth of an inch, and to record its position with a Maltwood's finder.

The frustule thus selected becomes a valuable unit of comparison between different objectives, the distinctness with which the striæ are shown indicating the definition of the glass, the manner in which the edges of the frustule are seen while the mid-rib and striæ are in focus showing the degree of penetration, and the appearance of the ends of the frustule when the centre is in focus giving a fair idea of the flatness of the field.

The illumination must be oblique, and the pencil of light must be thrown lengthwise along the frustule, which may be done by a common coal-oil lamp, with or without a small plano-convex lens, or other condensing apparatus, to concentrate the rays. This, however, is the least favorable mode of illumination, and will only succeed if very carefully used with the best objectives. Much better are the calcium and magnesium lamps, which may be condensed obliquely by means of a small plano-convex lens of one to three inches focal length. Either source of light gives a beautiful picture, the striæ being black on a white ground. The finest

*This is essential to the *best* and *most beautiful* appearance; it is not, however, indispensable for resolution, nor does balsam mounting make resolution much more difficult. For example I obtain excellent resolution of the balsam mounted *Amphipleura pellucida* on the Museum Möller's type-plate by Beck's immersion 1-10; price £6 sterling. The striæ are distinct and easily counted but paler than on dry specimens. I desire, also, to draw attention to the fact that Count F. Castracane in a paper read before the Royal Microscopical Society, March 1, 1871, expressly states that the year before he had made a photograph of the balsam-mounted *Amphipleura pellucida* of Möller's type-plate, obtaining good resolution and counting the striæ, which he gives as 4,000 to the millimetre. For this purpose he used a No. 10 of Hartnack, illuminated with monochromatic sunlight obtained by a prism. His negative "was blurred and rather faintish, so that it would not give good positive images." The power was about 640 diameters. Afterwards he obtained the same results with a No. 10 of Nachet (Monthly Microscopical Journal, April, 1871, p. 176). I may add that the Hartnack's No. 11 belonging to the Museum (price 250 francs) gives excellent resolution of the Amphipleura of Möller's type-plate and of other balsam-mounted specimens belonging to our collection.

results, however, are attained by the light of the electric lamp or of the sun rendered monochromatic by passing through a saturated solution of the sulphate of copper in strong aqua ammoniæ and of about the eighth of an inch in thickness.

Of these methods, that by sunlight involves least trouble and expense, and may be best managed as follows:—Erect a perpendicular wooden screen about two feet square on one edge of a small table. Cut in this a circular hole an inch and a half in diameter at about the height of the under surface of the stage of the microscope. On the outside of this hole mount a small plane mirror which can be adjusted by passing the hand to the outside of the screen. On the inside, cover the hole with the ammonio-sulphate cell. (A piece of dark blue glass will answer the purpose though not so well.) Now move the table to a window through which the direct rays of the sun can fall upon the mirror, adjust this so as to throw a nearly horizontal pencil of parallel rays through the hole, and place the microscope in the shade of the screen in such a position that the parallel blue rays will fall on the under surface of the amphipleura slide at an angle of from fifty to seventy-five degrees with the plane of the slide (I suppose the frustule to be examined has first been found by ordinary day-light or lamp-light). Next place a small bull's eye or any other condenser of from one to three inches focal length (mounted on a separate stand or on a radial arm) in the parallel pencil in such a position as to concentrate the light, at the angle above indicated, upon the frustule under examination. After this nothing remains but to regulate the cover correction and the fine adjustment. The precise angle which should be given to the illuminating pencil will vary with the angle of aperture of the objective used. As a rule it should be less than half the angle of aperture of the objective, and 70° to 75° is the maximum angle which should be given even for objectives of 170° angle, a greater angle, distorting the image without improving the definition.

The same results can be obtained by using a heliostat to fix the direction of the solar rays, and obtaining obliquity by an achromatic condenser of from 130° to 150° suitably decentred. On account of the stability of the illumination this method is especially suitable for photographing the Amphipleura, but the simpler method above described answers every purpose if the object is to compare objectives.

As to the result I may say that I have not yet met an immersion lens by any first class American, English, or Continental maker of an actual focal length of $\frac{1}{8}$ inch or less which did not, in my hands, resolve the Amphipleura more or less satisfactorily. I have even succeeded with an immersion $\frac{1}{5}$ of Mr. Tolles' obtaining a good photographic negative of two frustules well resolved with only two hundred and fifty-six diameters. My friend, Dr. J. W. S. Arnold of New York, writes me that he has obtained resolution by a Wales's immersion $\frac{1}{6}$.

A great difference exists, however, as to the manner in which different objectives, even when of the same power and by the same maker, will exhibit them, and for myself I have obtained the best results only with the finest immersion glasses of Messrs. Wales, Tolles, and Powell and Lealand. Spencer's recent objectives I have had as yet no opportunity of trying. With dry objectives the task is more difficult, still I have succeeded tolerably with some of the dry objectives of the above makers, and it was as seen with dry objectives that Messrs. Sollitt and Harrison first observed the striæ, though they could have glimpsed them but imperfectly or they would not have set them down at one hundred and thirty thousand to the inch.

In illustration of the appearances which ought to be obtained by a first class immersion objective of adequate power, the liberality of the Editors of the NATURALIST enables me to present herewith a Woodbury print from a negative, representing portions of two Amphipleura frustules as seen by an immersion objective of Mr. Wm. Wales of Fort Lee, New Jersey, magnified about fifteen hundred diameters. The lower of the two frustules proved on a careful count in the microscope, to have ninety-five striæ to the $\frac{1}{100}$ of an inch. This circumstance puts it in the power of every one to compare the two frustules, and to determine the precise magnifying power of the print.

The objective used was made by Mr. Wales nearly three years ago. It was named a $\frac{1}{50}$ but is in fact a lower power. On measurement I obtained the following data. Magnifying power, without eyepiece, at fifty inches distance from micrometer to screen eight hundred and ninety diameters uncovered, twelve hundred and fifty diameters at full correction for cover; angle of aperture at uncovered 110°, at full cover 130°; at uncovered the objective is, therefore, $\frac{1}{18}$ very nearly.

The photograph was taken without an eyepiece, the magnifying power being obtained by distance: owing to the moderate angle of the objective the picture was freer from diffraction fringes and consequently handsomer than any Amphipleura picture I had previously obtained, for this reason only it was selected for reproduction. Since it has been in the hands of the printer, however, it is only fair to say that I have obtained equally beautiful pictures with the same power by an objective made by Tolles of 140° angle, as well as by an objective of Powell and Lealand, both used without eyepieces. Copies of these pictures I have sent to the Editor of the department of microscopy of this journal for exhibition. I suspect each maker would claim that the picture by his objective was the best. For myself I regard them as nearly equally good, and think that to discriminate slight shades of excellence between objectives of this high grade, it is necessary either to give a much higher power, by distance or eyepiece, or else to use some more subtile test, such for example as the finer bands of the Nobert's plate.

My present object is not to advocate one maker or another, but to present an image of what the best glasses of several excellent makers will do with ease if properly handled, and to those who are influenced by more partisan feelings I need only suggest that less than two years ago no American microscopist had been able to see any striæ on this well marked diatom, and that those who had made the attempt were disposed to regard the observations of the Hull naturalists, made over ten years before, as quite fictitious.

In conclusion I need only mention that the illustrative print was reproduced from my negative by "The American Photo-relief Printing Company" No. 1002 Arch Steet, Philadelphia, Pa.

WHAT IS TRUE TACONIC?

BY PROF. JAMES D. DANA.

The true use of the term Taconic should be learned from Prof. Emmons's first application of it when he made his formal announcement of the "Taconic system." In his final New York

Geological Report, 4to., 1842, the rocks so-called are those of the Taconic mountains, on the borders of Massachusetts and New York, together with the quartzite, limestone, and slates adjoining on the east,* and not the slates far west of these mountains;† moreover the slates, the rocks of the mountain, were the typical beds, and not the quartzite. Hence, if there are any Taconic schists or slates, those of the Taconic range are the rocks entitled to bear the name, being Taconic geographically, and Taconic by the earliest authoritative use, Prof. Emmons the authority.

Prof. Emmons, in his Agricultural Report, subsequently published (in 1843), announced the Primordial beds of Bald Mt. (near Canaan Four Corners, in Columbia Co. N. Y.), as *Taconic* also; but this did not make them so. He referred to the Taconic the Black slates of northern Vermont, since shown to contain primordial fossils; he searched the country north and south for other Taconic rocks, and found them as he thought; and he set others on the search, not only in this country, but over the world. But all this has not changed the fact that the true Taconic beds, if any are such, are those he first so announced; and that the rest, so far as they are of different age from these, younger or older, have been dragged into the association without reason. The Taconic rocks of Berkshire and of the counties of New York just west always bore the most prominent part in his later descriptions of the Taconic system.

The error on the part of Prof. Emmons, in referring beds of other ages to the Taconic system, is not surprising considering the difficulties in the case. But it was no less an error; and his name as a backer cannot make the wrong right.

---

*Professor Emmons opens the subject of the "Taconic System" in his final Report (1842) by saying that it extends north through Vermont to Quebec, and south into Connecticut; but the only rocks he describes as the rocks of the system are those of Berkshire County, Massachusetts, and their continuation westward into New York. These are the typical rocks on which the system was founded. On plate xi, four figures representing sections across this particular region are given. The only Vermont observations are contained in the only other section on the same plate representing a section from Lake Champlain to Richmond, Vt., through Charlotte. No description of the rocks of this section is to be found in the text of the volume.

†In figure 4 of plate xi (referred to in the preceding note) representing a section through Graylock, the "Taconic slate" stops just west of Berlin, Rensselaer County, New York, the slates on the west being put down as "Hudson River shales," and in figs. 2 and 3, the boundary is near Petersburg, north of Berlin. The extension of the Taconic to the Hudson River appears first in Prof. Emmons's Agricultural Report, published in 1843.

Geologists now regard the slates of Taconic Mt. and the limestone, also, as of Lower Silurian age, but later than the Potsdam sandstone. Logan refers them to the Quebec group. Whatever the period of the slates, or slates and associated limestones, to that period properly pertains the term *Taconic*.

THE STONE AGE IN NEW JERSEY.

[Concluded from March Number, p. 160.]

BY CHARLES G. ABBOTT, M.D.

ARROWHEADS.—No one class of relics of a savage race presents at once so great a variety of shapes, sizes and materials; and the former presence of "Indians," is more generally known to the people at large through the frequent occurrence of these arrow-points, than by means of any other style of weapon or implement; not even excepting the cumbrous axes that not unfrequently go to make up the piles of cobblestones that accumulate in field corners or by the roadside. One of the largest axes we have seen, which we have since sent to Sir John Lubbock, was found supporting a section of worm-fence, where it had been lying thus for at least a century.

These arrowheads, which are found scattered over every portion of the state, are, very naturally, much more numerous in some localities than in others; and as no one style appears to be peculiar to any one locality, a good series from even a very limited extent of country will usually represent the shapes and sizes found over the whole state. Any attempt at classification will prove a desperate undertaking, as no well marked style has yet been found which has not been duplicated by a second, varying a mere trace, and these slight variations go on without a break until the two extremes of shape are found to be connected by an unbroken chain of closely allied varieties. The Darwinism of arrowheads needs no supplemental theory to make it good, nor are there shapes that cannot be explained by a somewhat similar and more primitive one. Prof. Nilsson ("Stone Age in Scandinavia," Eng. ed., page 43) says "we may divide arrowheads into such as have,

and such as have not, a tang or projection for insertion into the shaft." Referring to Lubbock, in "Prehistoric Times," we find him, on page 98, quoting Sir W. R. Wilde, who divides the arrowheads into five varieties. Further reference to the two works quoted above shows us, in the drawings, that whatever they have illustrated from the north of Europe or from Terra del Fuego is also to be met with here in New Jersey. We propose, in figuring the various shapes that we have so far met with, to follow Prof. Nilsson in separating the specimens into those with and without tangs or projections; but we cannot undertake to follow him farther, where he specializes certain forms as harpoonpoints, etc., etc. That some were used as spears, as weapons in battle, and others as hunting spears, or for fishing, *i. e.*, harpoonpoints, is probably beyond question; but that they were not or could not have been used as arrowpoints is difficult to disprove; and while we propose to speak of certain specimens in order, as to their probable use, we will call them all "arrowheads." Ethnologists can reject

Fig. 31.

Natural size.

Fig. 32.

Natural size.

Fig. 33.

Natural size.

Fig. 34.

Natural size.

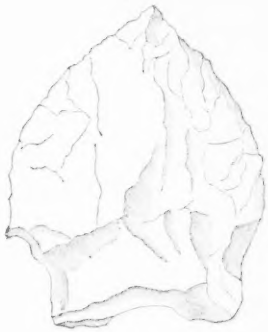
the text if they see fit, but we trust the illustrations will be interesting to those who desire to study them carefully, and with whom specimens are scarce. Arrowheads with tangs or projections for insertion into the shaft are somewhat less abundant than those without the projection; but they are of far greater variety of outline, and vary more in their size, running into spear or harpoon-

points. The most common shape of tanged arrowpoint is the small jasper specimen given in Figure 31. Unlike some forms,

Fig. 35.

Natural size.

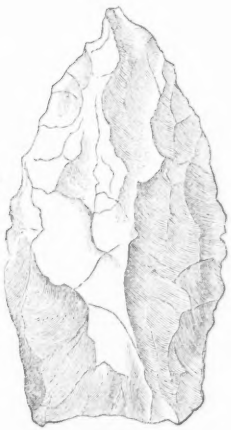
Fig. 36.



Natural size.

there can be no question as to the use to which this specimen was most admirably adapted as that of an arrowhead. The sharp point, well defined edges and deeply notched base, com-

Fig. 37.



Natural size.

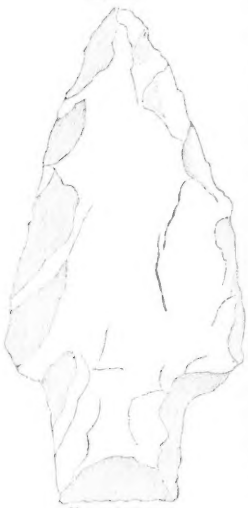
Fig. 38.

Natural size.

bine to render it at once secure in its attachment to the shaft, and efficacious as a weapon when discharged from a bow.

Of this pattern there is a remarkable uniformity in size, and the vast majority of specimens found are of jasper. A second form with a notched base is represented by Figures 32 and 33. Like the above, this form does not vary much in size, and is usually of jasper, but by no means invariably of that mineral. Slate was considerably used, but accuracy and general elegance of outline were not secured in using that material. We think that there can be no question as to these being used exclusively as arrowheads, but the same shape of greater dimensions would have been efficacious as harpoonpoints. The specimen (Fig. 33), it will be noticed, has serrated edges. This is a not uncommon feature of many of the smaller specimens, but generally these serrated specimens are broken. A careful study of over a hundred examples has explained this, we think. In comparison with the same type with smooth edges, we find that they are invariably much thinner. To secure the serrated edge, it was probably necessary to make them so; and of course these thin specimens were more frequently broken in the manufacture and more liable to injury in the daily wear and tear to which they were subjected. A third form of notched arrowheads with a projecting base is seen in that figured in the illustration (Fig. 34). In general appearance it is much like the preceding, but the object of the notch in the centre of the base below does not appear. The specimen is of a black, slaty stone, thin, with the sides indistinctly serrated. We have met with no similar figure in any work on the subject of stone weapons. In New Jersey, at least about Trenton, they are found occasionally, a dozen or more examples having been seen by

Fig. 39.



Natural size.

Fig. 40.

Natural size.

Fig. 41.

Natural size.

the writer. Of these specimens there was no variation in size, mineral, or peculiarity of base. A fourth form, and a very common one, is that given in the five illustrations (Figs. 35, 36, 37, 38, 39). In these examples we see the one common character of an unnotched base, and that the blade of the arrow is considerably wider, the width increasing abruptly in three specimens and less so in the other two. The specimen (Fig. 35) is of jasper, beautifully wrought, and very accurately bevelled from the centre to the edges, which are smooth. The length, one inch and three-quarters, decides its use, that of an arrowhead only. The specimen that approaches this most nearly is that given in Fig. 39. This is made of sandstone and is one and three-quarters times as large as the former. It is well made, considering the material, and if used as an arrowpoint must have required a very heavy shaft and powerful bow. A series of specimens, figured by Prof. Nilsson as coming from Mexico, Ireland, and Terra del Fuego, and all bearing considerable resemblance to the illustration we have given, are called, one an "arrowhead," another a "harpoonpoint." We will leave it to be decided in future, if it can be, to which class this specimen really belongs. Fig. 38 is a modification of the preceding, about two-thirds the length, and of similar mineral. It is not as frequently found as the other, but is not a rare form. It appears to us to be better adapted to arrow purposes, but is nevertheless well adapted to use with a stouter shaft than an arrow and wielded as a javelin. Figs. 36, 37, 38 and 39 are further illustrations of this type of based arrowhead, all of which have some peculiarity of their own. Fig. 40 is the natural size of a form that is occasionally found. It does not appear ever to have been more acutely pointed or

Fig. 42.

Natural size.

Fig. 43.

Natural size.

sharper sided than now, and is an innocent looking affair. It is as difficult to conceive of the use of so small a specimen as it is to conjecture how the larger ones were utilized. Yet they occur in sufficient numbers to show that they had an especial adaptation. We cannot look upon them as toys for prehistoric infants; there is too much work about them for that. The following figure (41) is of similar dimensions, but appears to us better outlined for an arrowhead. On a slender reed, if discharged with force, it would unquestionably bring down a large bird or squirrel. A much larger and very accurately outlined style of arrowhead is that illustrated by Fig. 42. These are never well finished except in outline, are of slate and rough and uneven on their broad surfaces. This occurs from the peculiarities of the mineral. It is not an abundant form. Beautiful quartz arrows of nearly the same general shape as the preceding, but much more finished specimens, are frequently found. Quartz seems to have been a very favorite mineral with the ancient arrow makers, and almost every shape we have found in other minerals is reproduced in this, except that they are almost always small, and so were used only as arrowheads. Figure 43 is a prevailing style of arrowhead, three and a half inches long, and one inch in breadth at the base of the blade. It is of a slaty stone, and from great age or other causes has lost its acute point and well sharpened edges. The base is similar to that of the slate arrowhead above described; and appears to be sufficiently large to render a secure attachment to a shaft feasible. If originally as sharp at the point and along the edges as are some jasper specimens, it was then capable of doing considerable execution. They are quite abundant, but their shape has rendered them very liable to be broken, especially on stony ground; and we therefore find the majority of this pattern in a more or less fragmentary condition. Figure 44 is a style of arrowhead that presents one marked peculiarity. It has no point. Otherwise agreeing very well with Fig. 36, it has that difference

Fig. 41.

Natural size.

Originally it had a point; of this we feel confident, but as this is the most fragile portion of an arrowhead, of course it is the most likely to be broken and such has here been the case; but the weapon was still deemed worthy of preservation, and has therefore been chipped to an edge, where the fracture took place. Whether used as an arrowhead afterwards or not, may perhaps be questioned. The specimen as it now is certainly bears much resemblance to certain chipped jaspers, to which we will call attention hereafter. They are of frequent occurrence and vary very much in size, as though all sizes of arrowpoints were occasionally thus repaired, even the pigmy specimens that we have already figured and described.

Fig. 45.

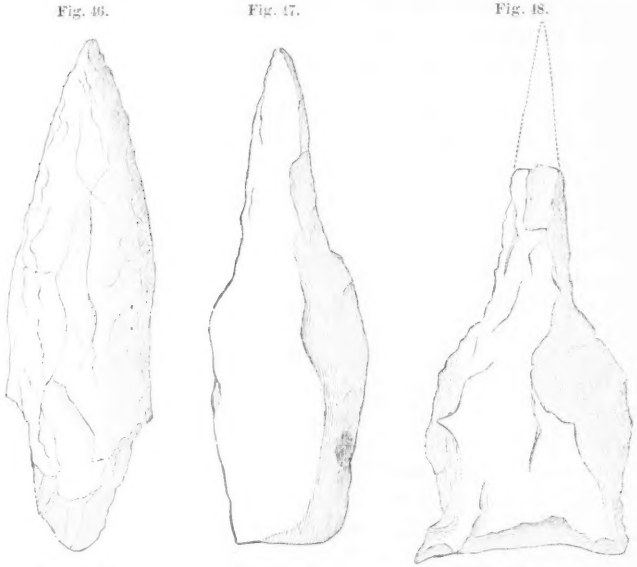
Natural size.

An interesting and quite abundant form of arrowhead is that given in Fig. 45. They occur of every variety of mineral that has yet been met with by us, in the shape of "relics," but the very great majority are in a fragmentary condition, usually only the base and a small portion of the shaft remaining. The specimen figured is of jasper and is remarkably perfect. The point is somewhat blunt, but the edges are pretty sharp. The slender stem is as thick as broad, and there is but little tapering from the quadrangular base to the point. In June, 1871, we forwarded three perfect and several broken specimens of this form to Sir John Lubbock, who has since written us — "As to the long pointed forms of which there are three nearly perfect specimens, besides some fragments. . . . . I am disposed to regard them as arrowheads, but would only express this opinion under reserve." There is every reason to believe that the first owners of these stone implements were moderately careful of them, and no little skill was required to work them successfully out of the materials they used. Taking this into consideration, we believe it is safest to give to a specimen that name which expresses the use involving the least risk. Now such a specimen as this is assuredly very easily broken, although this has stood safely the exposure of several centuries. To be placed in the end of a spear handle, and used as such, to thrust at fish, etc., would involve more danger of its being broken, than if placed at the end of a slender shaft it was shot into the side of

some animal or bird, and so secured unharmed for future use. Theorizing in this way, we believe, without reserve, that this form was exclusively used as arrowheads.

A decided variation from the square tanged arrowheads, is illustrated by Fig. 46 which represents a large arrowhead, admirably chipped from flint, or a bluish gray mineral resembling it. While we have occasionally met with specimens like it in our own neighborhood, it is really a "sea-shore" form and was probably largely used in shooting or harpooning fish. Along the shore of Delaware Bay and in Delaware, near the break-water, and in similar

Fig. 46. Fig. 47. Fig. 48.

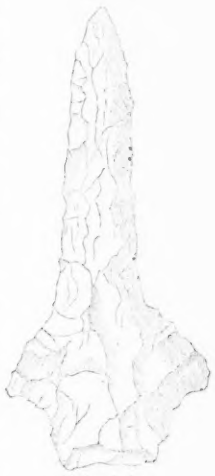


Natural size. Natural size. Natural size.

localities, it is the prevailing form. Three inches long, and but seven-eighths in width, it has a very acute point, and would offer but little resistance to the water. The tang is so shaped as to permit of its being securely fastened to a shaft, and yet easily removed. The specimen is beautifully reproduced in every feature, but length, in quartz specimens. In quartz, this style is abundant, and its size shows it was used only as an arrowhead, in ordinary upland hunting.

Figures 47 and 48 represent two allied forms of slender stemmed arrowheads, allied to each other and to the preceding two varieties. They are of slate, moderately well made and of a length that suggests the spearhead as well as arrow. They are, neither, as frequently met with as the preceding forms, with prolonged stems; but cannot be called rare forms. It has been suggested by an esteemed contributor to the NATURALIST, that these broadly based forms were used as target arrows, the stem only perforating the target, and so they were not lost. But we do not believe so much work would be spent upon arrowheads, for such a purpose only, and opine the prehistoric infants learned to shoot by other methods. Indeed, such must have been the mode of life at this time, that it was a matter of killing or starving, and under such circumstances man's capabilities to climb, run or shoot correctly are very quickly and thoroughly developed. Indeed, correctness of aim may have been inherited then, as well as faculties we now possess are inherited by us.

Fig. 49.



Natural size.

Figure 49 represents a variety of arrowhead, of which we have only seen the one specimen. Beautifully wrought in dull green jasper, it has the slender stem of the immediately preceding forms, with barb-like projections immediately above the base. It is most unfortunately broken, so as to render it impossible to determine all its features. Probably, the barbs were not repeated lower down, and the specimen was broken very near the original termination. Unlike the other elongated-stemmed specimens, this is thin and flat, and the whole aspect is that of a delicate, easily broken form. This fact makes us doubtful about its use as an harpoonhead; although it would be most admirably adapted for such use had the base been sufficiently prolonged to permit the side projections to operate as barbs. We do not find in Nilsson's work on the "Stone Age in Scandinavia" any harpoon-point that resembles this, which more naturally suggests that use, than any of the specimens he figures as having been so used. It

seems incredible that a form so easily destroyed as this should finally have been picked up in its present condition. In a very stony field that for a century has been under uninterrupted cultivation. We have to refer to one more form of arrowhead with projecting base. For delicacy of finish and beauty of outline it is unequalled. As will be seen by the illustration (Fig. 50), the base is broken off, but we can feel confident that it was sufficiently prolonged to enable the very accurately finished barbs to be effective. We imagine the prehistoric hunter who supported a quiver of arrows with such heads as these did not waste them on small game. However great the skill of an arrow maker, to turn out such work was undoubtedly a tedious operation.

Fig. 50.

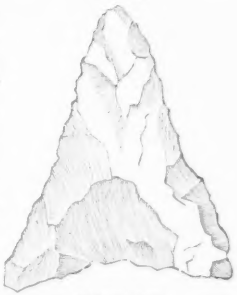
Natural size.

The second great division of arrowheads, which furnishes less variety in shape, is simplified in its study by the greater uniformity of size, and there is proof from this alone that their use was for shooting purposes only. We have not yet collected a single plainly based specimen, *i. e.* without a tang, that was too large to seem fitted for arrow purposes, or by its size suggested any other use. This class may be further subdivided into such as have straight, convex or concave bases. The largest number belong to the last series; the next in number to the second series and the fewest specimens are those with straight bases.

These remarks on relative abundance are liable to be upset at almost any time. As in the case of axes, so we occasionally meet with "deposits" of arrowheads;" the storehouse, as it were, of a tribe or perhaps of an arrow maker; and as in such cases there is always a predominance of one form, so it may be that other collectors have a majority of straight based specimens from their locality; or a future "find," will change the relative proportions which we have given. No predominance of any one form, however, marks the site of the dwelling and workshop of the arrow maker. In some cases the variety is wonderful; and the broken, unfinished specimens suggest that variety was continually aimed at by the "flint chipper." We have seen several forms at such a locality, that we have not yet met with in a finished state.

These sites of skilled arrow-makers' workshops were usually on projecting points or bluffs overlooking a broad expanse of country; and when once visited, are known immediately by the countless numbers of thin, splintery flakes that cover the whole ground. One such place in particular had evidently been so occupied for many generations, or by a score of arrow makers during their lifetime, considering the vast amount of chips and refuse material on the ground. It was a paradise for the mineralogist, for all our mineral productions, suitable for chipping, seemed to be there in abundance. After a rain, when the chips were free from dust, the many colored jaspers presented a beautiful appearance. Isolated specimens of minerals, available for arrow making, are frequently found in the fields, that do not belong there according to the given "localities" of mineralogists. One of the finest agates we have ever seen, was a partially chipped mass found just beyond the town limits of Trenton, N. J.

Fig. 51.



Natural size.

Fig. 52.

Natural size.

Fig. 53.

Natural size.

Triangular arrowheads, with concave bases, are very abundant and present some little variations in detail. Figure 51 is a beautiful specimen of one of these varieties, and is of a shape and size that we frequently meet with. They are mostly of black quartzose stone, or cut from a hard piece of slate. The specimen figured is of yellow jasper, with veins of white quartz running through it. A second illustration of this form, giving about the minimum size, is that of Fig. 52. It is one of the handsomest specimens that we have ever seen. It is cut from a greenish gray jasper, and remains in its perfect condition. Like the preceding this size and form also is mostly represented by black specimens cut from hard stone, but one that is much more brittle than is this many colored jasper, of which so many of our arrowheads have been made. A third variety of this class of

arrowheads, is given in figure 53. The base is so slightly curved as to make one doubt where to place the specimen. It is very nearly an equilateral triangle, but is particularly to be noticed, in that it has not been made with a well defined point; or if so originally, has since been sharpened down to a curved edge, and again used as an arrowpoint. Such arrowheads must have been shot with tremendous force to render them effective, for the cutting edge is never sharp as points that have been chipped; and as they now are, these curved topped specimens seem better adapted to crush than to penetrate. The specimen described is cut from yellow jasper or a mineral approaching it. It has not the gloss that jasper usually has. A variation of the form immediately preceding this, is given in Fig. 54, of slate, but well cut: this style is very sparingly met with. The peculiarity, as will be seen at a glance, consists in the manner in which the point has been chipped. A single specimen of this style would probably excite no comment. The peculiarity would be considered as resulting from a chance blow of the arrow maker. This however is proved not to be so from the fact that a score or more have been gathered, each, in size and mineral, the fac-simile of the others. It is probable that one maker may have fashioned all that we have found, and the style originated and died with him.

Fig. 54.

Natural size.

A handsome form is represented in Fig. 55. It has the appearance at first glance of having been barbed as in Fig. 50 but the carefully chipped sides of the base induce us to believe that it is now in its original condition. With a shaft much narrower than the base of the specimen, this would be one of the most effective arrowpoints that we have figured. It is not a common variety in this neighborhood (Trenton, N. J.) but we have met with quite a number precisely of this pattern in the collections of others. They are usually of jasper; very smoothly chipped and are thin and easily broken. The fragments of this form are much more abundant than of many others.

Fig. 55.

Natural size.

Straight based specimens, as given in Figs. 56, 57, 58 and 59, are very frequently picked up where arrowheads are found at all. Used wholly in bow and arrow hunting, they are scattered pretty much every where. Falling by chance, hither and thither when the hunter failed to strike the game, they have been left for anthropological entertainment until our time, to be gazed at and their workmanship admired. The most usual form of this class is the plain triangle (Fig. 56). Of white or rose quartz or of black slaty or quartzose stone, they present, in the field, so much of a contrast to surrounding pebbles, as to be readily detected and picked up. This same even edged triangle varies considerably in breadth and length, the extreme in length being the quartz arrowpoint (Fig. 57). Between these two extremes, all the variations of relative length and breadth exist. This latter figure is perhaps a little more abundant than the preceding, and when evenly cut from a piece of veined or rose quartz is a very beautiful specimen of ancient stone work. The minimum size of equilateral triangular arrowheads of this pattern is shown in Fig. 58. This specimen is cut from a piece of dark chocolate jasper. Its size is usually found cut from black stone, and is generally of equally good workmanship. Like the more slender, green jasper specimen (Fig. 52), it must have been used only in securing small birds and mammals. A rare form of this class is the pretty specimen (Fig. 59). This is cut from a piece of greenish jasper, and while very peculiarly outlined, still bears some resemblance to the specimen already described (Fig. 55). The base also approaches that of the beautiful specimen, Fig. 45. Indeed, we were at first inclined to believe that that form was intended, but the narrow

Fig. 56.

Natural size.

Fig. 57.

Natural size.

Fig. 58.

Natural size.

Fig. 59.

Natural size.

stem being broken, it was finished up as we now see it. Lately we have seen several stems like it, but smaller, and as they are all thinner than the stemmed arrowheads, and show nothing of the well marked central ridge that they have, we believe that this style was designed, just as it is, but probably for some especial purpose — some particular game. They are about as scarce as any one variety, so far as our experience in collecting goes.

Fig. 60.

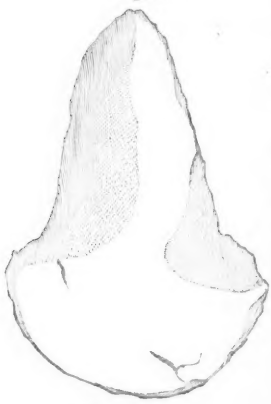
Natural size.

The leaf-shaped arrowhead and its modifications, and those arrowheads with convex bases, are well represented in numbers, in the usual day's "find" in any neighborhood good for collecting. The plain leaf-shaped form (Fig. 60) is the prevailing variety, and the difference in size in a large series is but very slight. They are generally chipped from white quartz, and exhibit careful workmanship. The point and edges are invariably sharp; the indestructible nature of the mineral having helped to preserve them until this time. When first lost, who can say? A variety of this form, verging into the plain triangle is shown in Fig. 61. The plainly notched base shows how it was attached to a shaft, which does not appear so readily in the case of the preceding form. The present form is but seldom met with. So far they have varied but very little in size or material (jasper) from the one figured. Another and peculiar form is shown in Fig. 62. This specimen is of mottled slate, and is larger than the general run of leaf-shaped arrow heads, even of that given in Fig. 60. Its size indeed suggests the spear, and we are somewhat inclined to think that an arrow with such a head would be a very uncertain weapon, in the hands of howsoever good a marksman.

Fig. 61.

Natural size.

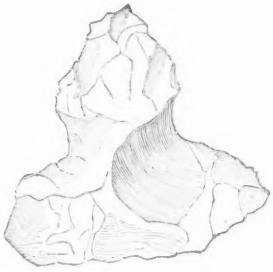
Fig. 62.



Natural size.

In continuing the subject of arrowheads, we have a few words to say concerning certain forms that have more or less affinity to those already figured, but have peculiarities of their own, worthy of some special comment. The first of these specimens is illustrated by figures 63 and 64. While bearing some resemblance to each other, they are not both fragments, as they appear; Figure 63 being evidently a finished specimen, as the base is chipped and not broken. This fact renders it probable that the other (Fig. 64) has had a chipped base of similar form, which has since been broken. Both have had, and one still has, a very good point. They are thick and heavy; strong enough for harpooning, but are not long enough to penetrate sufficiently deeply to kill, say a sturgeon or gar. When these were in use, our pickerel

Fig. 63.



Natural size.

Fig. 64.

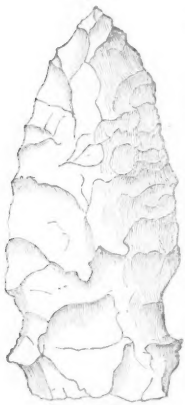
Natural size.

may have been much larger than now, and in that case they would have been effective in spearing them, but are too cumbrous for the slender Esoces that are now found in our waters. In works on prehistoric remains, we do not find this form figured or described in either stone, bone, or bronze. Unless one or two fragments that we have belong to this form, we have never met with any other specimens than the two here figured. The specimen given in Fig. 63 is of jasper and heavier in all its details than the other which is of lighter material and more smoothly chipped throughout.

A third example of arrowhead exhibiting certain peculiarities is represented by Fig. 65. It has been frequently remarked that arrowheads, wherever found and of whatever age, all have very much in common; and if a collection from all quarters of the globe was to lose the labels, it would be a difficult matter to de-

termine the locality of each, unless the mineral, from which they were made, would decide the question; and another interesting feature is the similarity between arrow, spear and harpoon points of an age long past and those now being used and made by the savages who are still more or less completely in their stone age. Bearing this in mind, we call attention to the "harpoonpoint," which in all important features is identical with one figured by Prof. Nilsson,* and concerning which he says, "the stone points (for harpoons) vary in shape; sometimes they are as in pl. iii, figs. 45, 47. Such are likewise found in Scania . . . . The broad head seems to indicate that they have been harpoons rather than arrowheads. . . . . It appears to me certain that pl. x, fig. 203 has been the stone point of an harpoon. . . . A person who had long resided in Greenland recognized it at once as such." Here we see that a New Jersey and an ancient Scandinavian specimen, and a Greenland one of the present day are identical. If breadth of the head of arrowpoints is an indication of use as harpoons, then several that we have figured must be placed under that heading; but while they have unquestionably sufficient breadth, as shown in Figs. 36 and 37 and 38 and 39, they have not a notched or other style of base, that would secure a firm fastening to the staff of the implement.

Fig. 65.



Natural size.

Fig. 66.

Natural size.

Fig. 67.

Natural size.

Fig. 68.

Nat. size.

In concluding the subject of "arrow heads," in this present paper, we desire to call attention to two other examples of specimens having a marked similarity to those figured by ethnologists in works de-

* Stone Age in Scandinavia, edited by Sir J. Lubbock; plate x, fig. 203; and page 28.

voted to "relics" of other countries. Prof. Nilsson, to whom we have so often referred, figures on plate xiii, figs. 225–226, two "arrowheads", which he refers to (page 88) as spears which have been worn down and broken from use, and repaired; and considers the specimens to have been once like others referred to, about six inches in length. Fig. 66, found here in New Jersey, is almost identical except in size, which is but one half that of the Scandinavian specimen. It seems not a little curious that not only do we find here pretty much all that characterizes the Scandinavian stone age, but even fragments that have been utilized are here found, showing that they, too, have undergone a similar restorative treatment.

Fig. 69.

Natural size.

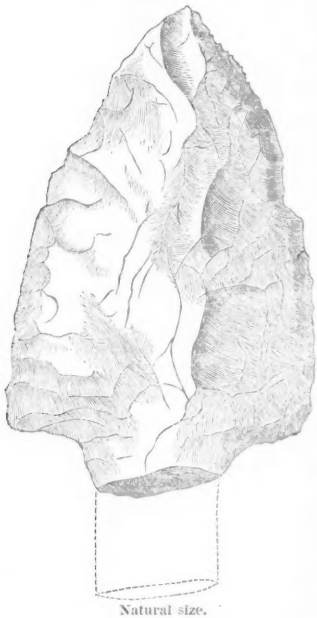
Figure 67 represents a handsomely chipped, rough-edged, bluntly pointed arrowhead; at least we will here follow Prof. Nilsson, and call them so, inasmuch as he has figured the same form, except, that they appear more roughly worked. He gives two figures that show the similarity better than a mere description can, on pl. ii, fig. 36, and pl. xvi, fig. 266. In size the specimens agree.

As, most frequently, stemmed arrows of any variety are in a fragmentary condition, we call attention to the illustration of a jasper arrowpoint (Fig. 68) which is perfect in itself and quite equals, in beauty of finish, any specimen of European flint chipping we have ever seen. There were certainly some very skilled arrow makers among our aboriginal, stone age people.

Taking a general survey of the collection of arrowheads that we have now studied in detail, one or two circumstances connected with them become evident and are worthy of comment. As a class, they are usually about one-third smaller than similar arrowpoints, as described and figured by various authors, from Europe especially, and, looking at them from a mineralogical point of view, we

find that the majority are made of minerals that are not to be found anywhere in the neighborhood, or even in the state; and as they were unquestionably manufactured here, the minerals in bulk must have been transported from a distance. The large jasper hatchet (or lancehead, Fig. 22) was one of a hundred and fifty, all of which were cut from the same mass, and considering them to weigh eight ounces each, we have in them a bulk of stone not pleasant to carry as transportation was then effected — on men's backs probably. Indeed, near where these were discovered, was afterwards found a mass of the same mineral which was quite heavy but we cannot now recall the exact weight.

Fig. 70.

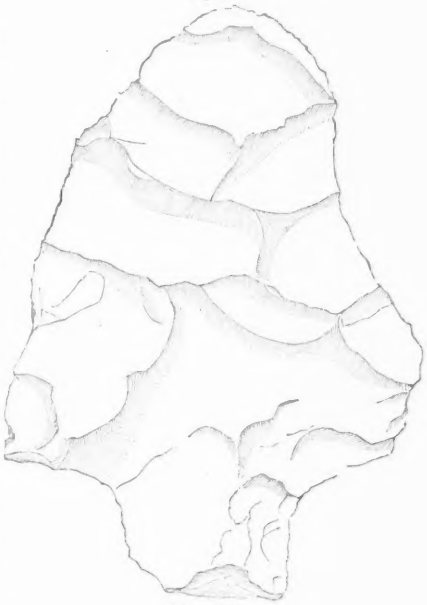


Natural size.

Spears. — There are to be found in almost every field, where arrowheads are ever met with, certain large specimens having all the general features of the preceding, but were unquestionably intended for other purposes. Such specimens we have designated "spears," a term which may or may not include "lances," as what we shall presently denominate a lance may really not have been so used. Fig. 69 represents a perfect specimen of the spear, it being, as are so many of the arrowheads, provided with the tang, or projecting base; and in general appearance resembles several of the forms of those smaller implements. This specimen is of jasper. Very well, but not as finely, cut are many arrowpoints; and it shows by its whole aspect to have been wrought out with a view to strength and durability, as well as being effective in the chase or in battle. The point and sides are still very sharp and capable of inflicting a fearful wound if thrust with a moderate amount of force. The specimen figured is three and three-quarters long by a little less than one-half in width. This size is about the average of the spears such as we are now describing.

Fig. 70 represents an allied yet much handsomer form, which is quite rare and so far has been always found (by us) in a fragmentary condition. It is simply an enlargement for spear purposes of a common form of arrowhead. The workmanship of this specimen excels that of the preceding, which may, however, be due to the greater tractability of the mineral. Like the other spear we have figured, this specimen as a hunting implement or weapon in war is very formidable. With the ordinary force of a man's arm, such a spearhead would impale a sturgeon, and thrown as a javelin would probably cleave a man's skull. The sharply barbed base would make this more efficacious in the chase than some of the European specimens figured by Prof. Nilsson, which, however, are usually somewhat larger. Sir John Lubbock figures a modern Esquimaux spearhead in "Prehistoric Times," fig. 218, which is very innocent looking in comparison with this.

Fig. 71.

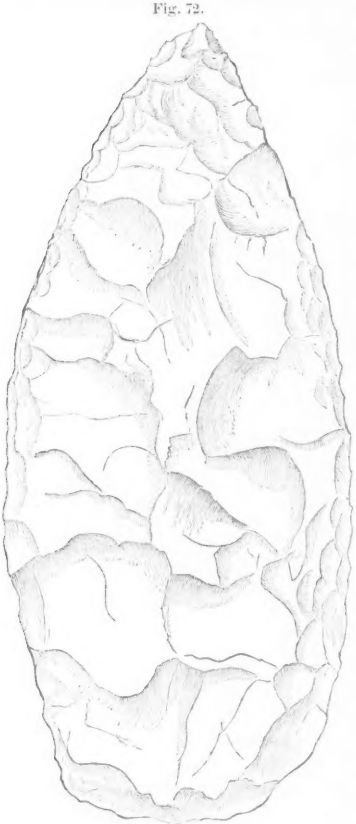


Natural size.

Judging from the abundance of stone implements that are made of a much less durable and easily wrought material than jasper, it would seem as though there was an ancient aristocracy, or at least, then, as now, there were two classes, a more wealthy, and a poorer one. Fig. 71 represents a very common, although invariably (so far) broken style of spearhead, differing somewhat from the preceding (Fig. 70), but closely allied, however, to it. This specimen is broader and has been longer. The base is merely a straight, narrow tang and suggests

the base of the preceding, which we have represented as similar to this. The two specimens each supply to the other the missing parts, or at least suggest them. These three allied forms of true spears are not abundant. Probably they constitute about one per cent. of the "find" in any locality, except, perhaps, the sites of the former labors of arrow makers. Here fragments of spears abound in greater proportion. Their use rendered them more likely to become broken than arrowheads would be; and we now find that a much greater proportion of them are broken, notwithstandin their much greater strength. Possibly their size, rendering them more conspicuous, has led to their having been more frequently gathered up, years ago, when their shape and beauty made them attractive and curious, before they were considered of scientific value. We know of three beautiful specimens of large jasper spears that were picked up by the grandfather of their present owner over one hundred years ago. Indeed, if we had now in our possession one-half of the specimens we gathered and lost, when rambling about the country during summer vacations, the illustrations of this paper would be far more attractive.

Fig. 72.



Natural size.

As we separated the arrowheads into two classes, those with projecting bases and those not so furnished, so we must also sepa-

rate the spears. Fig. 72 is a beautiful specimen of a spearhead of a kind of flint, and mineralogically is unlike any other specimen in our collection. It is the leaf-form of arrowhead enlarged and is of fine workmanship. As a weapon it must have been valuable, but it is difficult to conceive how it could have been sufficiently securely attached to a long shaft. It is little less than five inches in length, by two and one-eighth in breadth. We have never met with another specimen that was like it in all particulars, size included, but have seen them in collections made elsewhere in the United States and in South America.

Fig. 73.

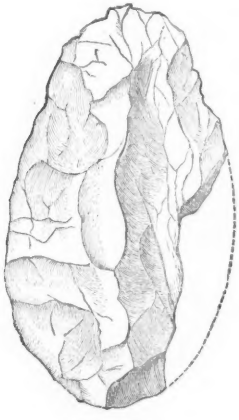
1-4 natural size.

LANCEHEADS.—Fig. 73 is a representative of an average specimen of those long, slender, finely edged slates, which we here denominate as "lanceheads." They are never wrought with that care which characterizes arrow and spearheads, but still have had sufficient care bestowed upon them to show that they were for some important purpose. They are very abundant, scattered promiscuously over the whole state, and turn up at odd times, every where and anywhere. Along the shores of our creeks and from the bottom of the Delaware River, upland and lowland, it seems to make no difference as to the character of the place, here or there, they are equally abundant. We cannot now remember how many specimens of them we included in a collection sent in the summer to London, but we believe that they, with the pile now before us, would number nearly a hundred. We have intimated that they were only of slate—this is not so. The "deposit" of which we have spoken already, of jasper specimens, of which the large hatchet figured was one, was composed of "lanceheads" very similar to this slate here figured. As all these "slate" specimens have a well defined, blunt base, we have thought that the handle or shaft must have been here attached, and if so, then we cannot look upon them as anything else than lances or javelins. The *majority* of "the jasper deposit" just referred to also had this same feature of a well defined base.

When such was not the case, we should call the specimen a hatchet. Specimens similar to these seem to be characteristic of "finds" in all parts of the globe. Our specimen certainly bears a strong resemblance to the Kjökkenmöddings lanceheads figured by Sir John Lubbock, after Worsaæ, in "Prehistoric Times," p. 230, figs 173, 174, 175. Our specimen is double the width and one-third longer, but we have met with some few that were identical in size with the illustrations quoted.

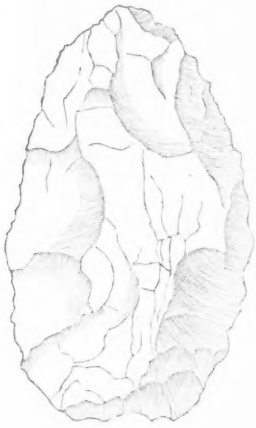
KNIVES. — Were the specimens (Figs. 74 and 75) found on the site of the former labors of an arrow maker, or were they but very rarely met with under any circumstances, we should be dis-

Fig. 74.



Natural size.

Fig. 75.

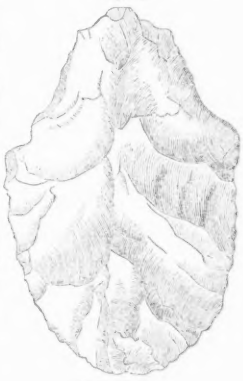


Natural size.

posed to consider them as only worked jaspers that had been left unfinished and were probably commenced for arrowheads. Such, however, is not the case. Such specimens as these are scattered singly, say one or two to an acre, over all the ground that we have searched for antiquities; and although they vary materially from "flints" that have been designated "knives" by Nilsson and Lubbock, still we have come to the conclusion that as knives they were used. One consideration must here be borne in mind, that it is almost certain that there was scarcely a single instrument but had many uses, and as pocket knives are now frequently a combination of various tools, so the rudely chipped jaspers had

a multiplicity of uses. The edge being the prominent characteristic of the specimens, cutting must have been the principal object in the making, and therefore we call them "knives." Commenting on a collection of antiquities forwarded to him from this neighborhood, Sir John Lubbock remarks, "the absence of flakes and true scrapers surprises me. How do you account for it? Is there no flint in the neighborhood?" There is no flint in the neighborhood, and as jasper, slate and sandstone do not flake off as readily and conveniently as flint proper, so we do not have in the abundance characteristic of European "finds," *true* "flakes" and "scrapers" such as may have been made by almost a single blow; and so too, our knives, if those we have figured be knives, have not a smooth edge, as a single plane of cleavage produces, but still would surely be effective for most of the uses to which any "flint" knife could be put. The specimens are always of an elongated, oval outline, and vary little from three inches in length by one and one-half in width.

Fig. 76.



Natural size.

Both sides are equally smoothly chipped. In some specimens, indeed in quite a large number, there is more of a curve to one side than the other, approaching in this the general appearance of the semi-lunar knives found in Sweden. (See Nilsson's "Stone Age," plate v. figs. 88–9.) Figure 75 shows this more, perhaps, than any other specimen in our collection. Mr. Lubbock has figured in "Prehistoric Times" (page 490, fig. 214), an Esquimaux knife, that certainly can be duplicated without difficulty, *without the handle*. Many of the more elongated leaf-shaped arrows, that had lost their points, might have been thus used, by placing the broken end in a bone handle and so converting the base and sides into the edges of a knife blade. As we do not often find arrowheads which give evidence of having been repointed, perhaps very many of the specimens now found without points were once inserted into bone handles, which latter have long since crumbled into dust.

Scrapers.—Every collection of flint implements found in Eu-

rope seems to have always a large number of rude implements that have been called "scrapers:" viz., tools for scraping and cleaning raw skins of animals, which were afterwards to be converted into clothing. Prof. Nilsson, besides these "scrapers," describes a "stretching implement," which may or may not be represented here by certain carefully cut jasper specimens, which we will refer to presently. Specimens that we here figure as scrapers (Figs. 76 and 77) approach somewhat to the figures and descriptions of Nilsson and Lubbock, but do not agree wholly with either. Fig. 76 will be found somewhat similar to the illustration in Nilsson's work, plate ix, fig. 188. It will be noticed, however, as in all our New Jersey specimens, that both sides are chipped. Specimens such as this and those following were sent to Sir J. Lubbock, who expresses surprise at the absence (in the collection) of "true"

Fig. 77.

Natural size.

Fig. 78.

Natural size.

scrapers. Admitting the dissimilarity between the European and the American specimens, we still claim for ours greater beauty of finish and fully as great adaptation to the use intended.

"Stretching Implements."—Prof. Nilsson calls by this name certain forms of stone implements, which he says resemble greatly "the bone implement, provided with a handle, which is there used for stretching the skins in order to give them the requisite softness." The figure that he gives is represented with a *sharp* edge, but he says, in the body of the work, that "the widened part, representing the edge, has been *rounded* off by *constant wear*, probably from being rubbed against leather or something of that kind." ("Stone Age in Scandinavia," p. 77.) The widened part of our specimens (Figs. 78 and 79) are not worn smooth in one sense but the ridges are not acute enough to endanger the leather by

cutting, and we can readily see that, provided with a handle, they would be well adapted to the use he mentions with reference to Scandinavian specimens. One argument in favor of these specimens being used for domestic purposes, is that we have found them numerous in certain localities, where the large number of fragments of pottery, "cornerushers," pestles, etc., shows that on that spot once was a dwelling or village of those ancient people who utilized the "relics" that we have been describing. As to their manufacture, we have but to remark that they appear to have been made from the mineral directly, and not from the bases of broken spearheads, our reason being that they are generally thicker and wider than spearheads; though, on reference to the spearhead (Fig. 69), it will be seen that the basal third of this specimen would make a "stretcher" very similar to the one we have figured here, 79. These stretchers or skin dressers are quite abundant. From one field of but eight or ten acres we have over seventy specimens, all agreeing remarkably in size and shape, and, with one exception, all are cut from jasper.

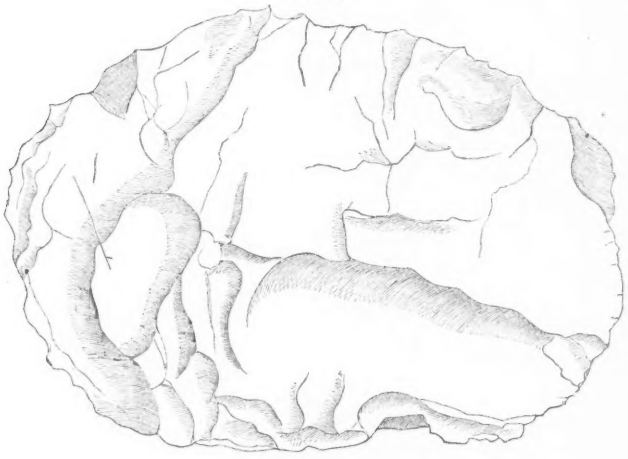
Fig. 79

Natural size.

Somewhat allied to scrapers, hatchets; and in a measure *sui generis*, is the next illustration we shall give. The specimen itself is a light yellow jasper "flake," subsequently chipped about its edges. If a "hatchet" handle were attached to the centre of the flatter side, or base, the stone would then make a comparatively good double edged axe or hatchet. If, however, a short bone handle had covered the straight side or base, then the specimen could have been used as a knife, or "skinner," although now its edge is too irregular and dull for skinning. When sharper, however, it could have been utilized in detaching the tough hide of the bison or a deer; but whether or not the bison ever roamed in New Jersey, we know not. Lubbock figures as "flint implements," a series of specimens taken from a tumulus at West Kennet, Eng., (Prehistoric Times, p. 153, figs. 147–50;) and to his figure 150 our specimen certainly bears great resemblance. As Sir John Lubbock

does not give any other name to the specimens, nor suggest their probable particular use; we can only follow his example, as to figure 80, and call it an "implement." This certainly is an easy, but scarcely satisfactory way of escaping a trouble, which perhaps is little bettered by the suggestion that just such a chipped flint may not, by its original owner, have been specially set apart for particular use or uses, but have been a sort of "handy come-by," valuable to crush a mussel, or crack a marrow bone, but never designated by its first possessor, as either the one or the other. Indeed, would not a people whose advancement was but thus far

Fig. 80.



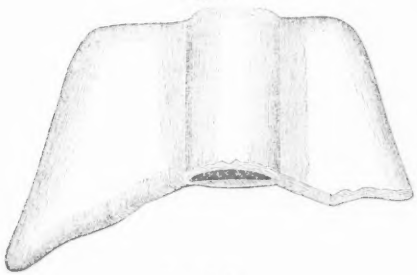
Natural size.

progressed—a stone-age people—be limited in the variety of implements, and adepts in the art of multiplying uses for a single simple article?

Perforated Stones.—In the fourth volume of the American Naturalist, page 380, we have described and figured a curiously formed "relic" found near Trenton. We now know that they are frequently found in the west, and since the publication of the notice of our Jersey specimen, a figure of an allied carved stone, from Vermont, has been published on page 16, of the fifth volume (1871). Figs. 81, 81*a*, is an ornament or "gorget" (Squier and Davis) found in the same field with the specimen we have

referred to (Amer. Nat. page 380, 1870). It is of softer material and perhaps not as finely finished as some similar specimens; but the hole that runs the whole length of the specimen is as perfect as any drilling in metal that we have ever seen. The width of the specimen in the centre is just one inch. The breadth at the top one and one-half inches. As in the specimen figured

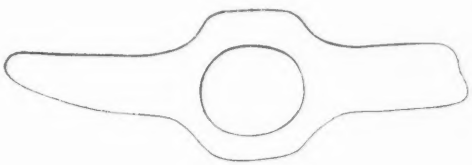
Fig. 81.



Natural size.

in the NATURALIST for March, 1871, p. 15, this has, also, the perforation slightly smaller at the apex than at the base. Another perforated stone is the elongated, quadrangular flat stone (Fig. 82). This specimen has been carefully polished and is very graceful in outline. The perforation near one end — the smaller — is evenly drilled from each side to the centre, where the two depressions

Fig. 81*a*.



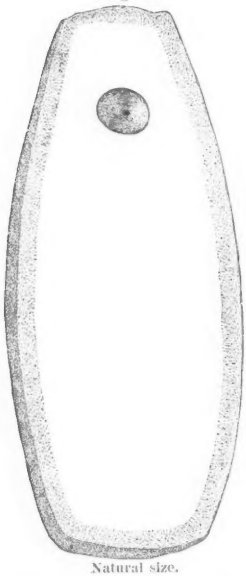
Section.

meet in an opening one-third the diameter of the drilling at the surface. The use is perhaps a matter of doubt, but the perforation suggests that it was suspended by a cord, probably around the neck. It has been suggested that it was used as an "ear drop."

FISHING-PLUMMETS. — Girdled, globular or oval pebbles, which have been designated "fishing-plummets," are very abundant. We

have never met with any having more than the one groove each, as Prof. Nilsson describes. Indeed, one of his specimens he mentions as coming from the Delaware River, Pennsylvania; and as ours (Fig. 83) was picked up from the shore of that river, *they may have belonged to the same net!* While the fact of the vast majority of these stones being found in the beds of rivers or on the immediate shores would naturally suggest the use now attributed to them, still very many are found upland far from any water at present; so that they may have had some other use than net weights, or have been lost in the transportation of nets overland.

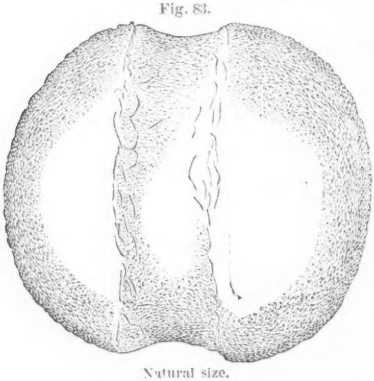
Fig. 82.



Natural size.

Pottery. — As we have nothing but fragments to offer, we will close our extended notice of "Indian antiquities" with a few words concerning these specimens (Figs. 84, 85, 86, 87). In the style of decoration, these will be seen to vary. On examining a vast quantity of such fragments, we find no other forms of ornamentation, but frequently a combination of two, three or all of these forms. Fig. 84 is part of the top of an urn or vase, and the rim, as distinct from the sides of the vessel, is well shown. On comparison with fragments figured by Sir John Lubbock, in "Prehistoric Times" (page 154, figs. 151–4), we find that the New Jersey specimens are not greatly dissimilar and are quite as handsome.

Fig. 83.

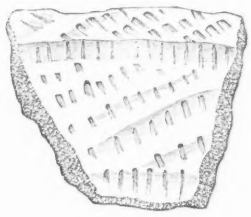


Natural size.

To what extent the "aborigines" were vegetarians, or were adepts in gastronomic science,

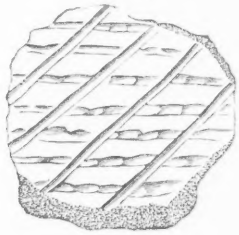
it is difficult now to determine; but besides the vast quantity of fragments of pottery, there are frequently to be found, long, cylindrical stones, with tapered and polished ends, that for want of a better name, perhaps, are entitled "pestles." They are too well known to need a figure given of any specimen, and their whole extent of variation is in length and diameter. The largest

Fig. 84.



Natural size.

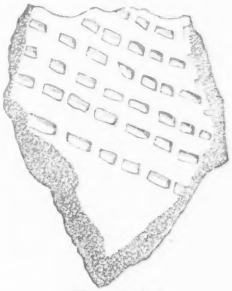
Fig. 85.



Natural size.

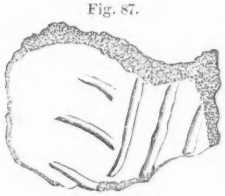
we have ever seen is in the possession of Dr. John W. Ward of Trenton, and was found near that place. It is seventeen and one-half inches in length, and scant eight inches in circumference. It is bevelled at either end and polished; indicating that the ends were used in crushing corn (?) by striking blows, rather than by rolling the pestle in the depression of a basin-shaped stone. Very many of these pestles are less uniform in their circumferences, being nearer an ovoid cylinder in shape than truly cylindrical, and again, some specimens we have gathered, have a somewhat polished surface at the middle, showing that the usual contact was there, rather than at the ends.

Fig. 86.



Natural size.

Fig. 87.



Natural size.

Very many of these "pestles" are of diminutive size, varying from three to seven inches, and of diameter in proportion. Their use is plainly indicated by the occasional presence of a shallow mortar; a circular flat stone, in the centre of which is a depression that has been gradually worn by the constant rubbing action

of the little pestle. Their use was unquestionably to prepare the paint used in the decoration of the face and body. Indeed, one specimen of such mortar and pestle, exhumed with a skeleton and some weapons, had a hard cake of reddish clay filling up the depression of the mortar, which was the more easily recognizable, as the surrounding earth was of a peculiar blue-black color, being an admixture of the surface loam and underlying blue triassic clay that is so abundant in the neighborhood of Trenton, New Jersey.

Of other implements belonging to our prehistoric kitchens, there is but little to be said, except of certain large, saddle-shaped stones that are claimed to have been used as the "mills" whereat, by the use of large pestles, maize was crushed before being used as food. Certainly several such stones as we refer to were admirably adapted for just such use; and we doubt not that to consider them as corn-mills is correct. They have invariably been too unwieldy to move from the fields for purposes of illustration; and in fact have varied so in shape, that no one illustration would give a general idea of the whole set.

The same remarks will apply to other large stones, that appear to have been utilized by the Redman, and are called "anvils," for want of a more correct designation. Dr. Thomas S. Stevens of Trenton, to whom we are indebted for many favors, has called our attention to one such anvil, which was found on the site of an "Indian" village. The stone in question is about twenty inches in height; has an hour-glass contraction at the middle, and has a level, circular surface at either end of about nine inches in diameter. Where contracted at the middle, it measures about five or six inches in diameter. The present shape of the stone, we found on trial to be admirably adapted for use as an anvil, or "bench;" by placing it before you, between the legs, and seating yourself upon the ground. Thus positioned, one could easily imagine himself a prehistoric arrow maker, resting one surface of a block of jasper upon the upper face of the anvil, and striking off the precious flakes, that a subsequent laborious chipping would transform to such delicate arrowheads as we have figured. Whether such an anvil as here described, was shaped from a globular boulder or not, is a very difficult question to decide; but judging from the mineralogical character of the implement, we consider that it originally had some resemblance to its present shape, and was afterwards chipped to perfect the uniformity of its hour-glass contraction.

We have now described typical specimens of our collection. It must be borne in mind, that they are all from one limited locality, except one axe, and that collectors may now have or may discover within state limits much that we have not seen. We may add to our own collection as the years roll by; but notwithstanding all this, we believe that the ground has been sufficiently gone over to warrant us in heading our article, the Stone Age in New Jersey.

NOTE.—Since the original manuscript of this article was written I have had an opportunity of seeing "Hæckwelder's Narrative;" and this missionary there states, that the New Jersey bank of the Delaware River, from Trenton to Bordentown, was occupied by a "great king" to whom the many lesser chiefs were subservient. This fact may explain why this locality is so singularly rich and varied in its forms of antiquities. May not the surrounding tribes have brought hither, as tribute, tithes of their choicest weapons, and thus explain why so many specimens of weapons of foreign minerals are gathered in the fields, which possess *naturally* none of the minerals of which so many of these implements, are made? As Hæckwelder was one of the earliest Europeans visiting these parts, his account is well worth referring to, whether our assumption be correct or not. It is interesting to know that the locality of which we have treated, was once a place of importance to the people whose scattered *relics* alone are left for us to study them by.

REVIEWS AND BOOK NOTICES.

SIEBOLD'S PARTHENOGENESIS.* Professor Von Siebold, well known by his first work on the Parthenogenesis of the bees and silk worm (*Bombyx mori*) gives here further statements of a similar development in *Polistes*, *Vespa holsatica*, *Nematus ventricosus*, *Psyche helix*, *Solenobia triquetrella* and *lichenella*, *Apus cancriformis* and *productus*, *Artemia salina* and *Limnardia Hermanni*. The facts reported are the results of observations, continued through a dozen or more years. The manner of observation, and the statement of the facts are equally interesting and important. They form a masterpiece and indeed a standard for every zoologist desirous of knowing how to observe and how to study. There are twenty-one observations concerning Apus reported from the years 1857 to 1869 at four different localities, in Bohemia, Croatia, Poland and Italy. The number of collected and investigated specimens for each observation varying between 21, 100, 500, 1000 and even 5796! Males were found only in Krakau, Breslau and Croatia. In Bavaria, near Gossberg, Siebold did not

* Beiträge zur Parthenogenesis der Anthropods von. C Th. E. v. Siebold. Leipzig. 1871. pp. 238, pl. 2.

find any males in ten observations in the same place in the years 1857 and 1869, although nearly 10,000 specimens were carefully investigated. The chapter on Polistes is really a masterpiece. In the concluding remarks is stated the law that in Hymenoptera (Apidæ, Vespidæ, Tenthredinidæ) the parthenogenesis development always results in males, while in Lepidoptera and Crustacea (Psychidæ, Talæporidæ, Phyllopoda) always females. The first, the Parthenogenesis resulting in males, is called Arrenotoxy by Leuckart; the second resulting in females is called Thelytoxy by Siebold. There are some observations recorded on an initial development without impregnation of the egg in vertebrate animals, by Oellacher on the hen, by Hensen on the rabbit, by L. Agassiz on codfishes. Finally, the fact that no male of the eel has been found is shaken; a fact which suggests that they are produced by parthenogenesis.—H. Hagen.

Ethnography of the Shores of Behring Sea.*—This well known author having visited Behring Sea nearly forty years ago, has now collected all the ethnographical facts of those parts, as its people are rapidly becoming extinguished and their customs are dying out. The chapters are: concerning the Aleuts; concerning Koljusches; the names of the people along the northern American and Asiatic shores; voyage from Kamtschatka to Sitka; reception in Sitka; the Koljusches in Sitka; the religion and legends of the Koljusches; liberty and slavery of the Koljusches; their exterior appearance; their industry together with that of the neighboring people, their dress and the material of it, their shipbuilding, the metallurgy, their food and vessels for preparing it; the Aleuts, their physical constitution, sexual customs, dwellings, shipbuilding and navigation, weapons of the chase and hunting, anatomy and medicines, sense of beauty and æsthetical enjoyments, legends and songs, numbers in the language and words for numbering of all people around the Behring sea. Finally, there is a chapter on the history of the instruments used for making fire by primitive people.— H. Hagen.

Early Stages of Dragon Flies.†—The dragon flies are said to

* Ethnographical observations and experiences on the shores of the Behring Sea by Prof. A. Erman in the Zeitschrift für Ethnology, 1870 and 1871. p. 295-326 p. 369-393. p. 149-175 p. 205-219 with a map.

† Illustrated Catalogue of the Museum of Comparative Zoology. No. V. The Immature State of the Odonata. Part I.—Subfamily Gomphina. By Louis Cabot. Large 8vo. pp. 18. Three lithographic plates. Cambridge. 1872.

be difficult to raise from the larva state, but the difficulty can be overcome, and we hope that this paper with the beautiful plates containing figures of so many forms, may excite students in entomology to rear our dragon flies in aquaria. It is this kind of work that tells in advancing science, and a work to which the labors of systematists are largely preparatory. Those who live away from libraries and museums can easily devote themselves to observing the habits and early stages of insects, and thus do as much, or even more, to advance entomology than they who give their time to describing new species. Mr. Cabot describes the immature stages (larva and pupa) of seventeen species of which four were raised and identified beyond any doubt. Dr. Hagen holds himself responsible for the determination of the species and gives a synopsis at the end taken from Mr. Cabot's description.

The Lens.*— In spite of the fire the first number of this new scientific journal has been reprinted and issued with commendable promptness. Among the original articles is a conspectus of the "Families and Genera of the Diatomaceæ," by Prof. H. L. Smith, which will prove very useful to students; while botanists will be interested in the list of plants about Chicago, by H. H. Babcock. Dr. J. J. Woodward describes a new method of photographing histological preparations by sunlight. Dr. Danforth contributes a useful article on the preparation and preservation of sections of soft tissues, and the editor gives us a list of the Diatoms of Lake Michigan with a description of a new Rhizosolenia (*R. eriensis*). The selected articles and miscellany are timely, and the whole appearance of the magazine very pleasing.

BOTANY.

Dispersion of Seeds by the Wind. — A Kerner, director of the Botanic Garden at Innsbruck in the Tyrol, has contributed a very interesting paper on this subject to the "Zeitschrift des Deutschen Alpen-vereins." In order to ascertain the extent to which seeds are carried by currents of air, the writer made a careful investigation of the flora of the glacier-moraines, and of

* A Quarterly Journal of Microscopy and the allied Natural Sciences: with the Transactions of the State Microscopical Society of Illinois. Edited by S. A. Briggs. Chicago. No. I. 8vo. pp. 64. 1871. With a lithographic plate and wood cuts.

the seeds found on the surface of the glaciers themselves, believing that these must indicate accurately the species whose seeds are dispersed by the agency of the wind. Of the former description he was able to identify, on five different moraines, one hundred and twenty-four species of plants, and a careful examination of the substances gathered from the surface of the glacier showed seeds belonging to thirty-six species which could be recognized with certainty. The two lists agreed entirely in general character, and to a considerable extent, also specifically; belonging, with scarcely an exception, to plants found on the declivities and in the mountain valleys in the immediate vicinity of the glacier; scarcely in a single instance even to inhabitants of the more southern Alps. M. Kerner's conclusion is that the distance to which seeds can be carried by the wind, even when provided with special apparatus for floating in the air, has generally been greatly over-estimated; and this is very much in accordance with the view advanced by Mr. Bentham in his Anniversary Address to the Linnæan Society of London, in 1869. Along with the seeds M. Kerner found, on the surface of the glacier, more or less perfect remains of a number of insects belonging to the orders Lepidoptera, Hymenoptera, Diptera and Coleoptera, which, like the seeds, belonged almost exclusively to species abounding in the immediate neighborhood of the glaciers.

The species of plants which are specially inhabitants of the higher mountain regions M. Kerner divides into two classes. In the first the seed or fruit is provided with an appendage of various kinds, to enable it to be carried easily by the wind; the species possess generally a short span of life, are continually shifting their habitat, will grow where there is scarcely any soil, and especially love to establish themselves in the clefts or on the inaccessible sides of rocks; their floating apparatus appears designed rather to enable them to reach these habitats, where no other plants could establish themselves, than to be carried any great distance by the wind. The second kind are much more stationary, have a greater length of life, require a richer soil, are unprovided with any apparatus for flight, and can advance only very gradually; they are consequently much less abundant than the first kind. From the above observations, and the fact of the existence of detached localities for some of the mountain species in the Tyrolese Alps, very remote from their more abundant habitats further south, M. Kerner

draws the conclusion that at a period subsequent to the glacial epoch a warmer climate than the present overspread that part of Europe, when the species referred to extended over a wide area, of which the present isolated localities are the remains.— A. W. B.

Mimicry in Plants.—In the January number of the London "Popular Science Review" Mr. A. W. Bennett brings forward some remarkable illustrations of this singular class of phenomena, which he divides under two heads:—those relating to the whole habit and mode of growth, and those which relate to the development of some particular organ or part. Of the former kind a very familiar instance occurs in the extraordinary resemblance between the succulent plants which form so prominent a feature in the flora of the sandy deserts of America and Africa, belonging to the widely dissociated genera *Cactus*, *Euphorbia* and *Hapelia*; and instances of this kind the writer thinks may generally be accounted for by similarity of external conditions. Far more difficult is it to explain the cases of "mimicry" which come under the second head, in which species growing either in the same or in different localities, imitate one another to a marvellous degree of closeness in the form and venation of the leaf, the external appearance of the seed-vessel, or in some other particular organ; and of this kind several illustrative drawings are given. It appears impossible to suggest any explanation of this curious phenomenon like that which has been brought forward in the case of similar close resemblances in the animal kingdom, viz., "protective resemblance" springing up by the operation of natural selection, and these singular facts seem to deserve closer attention than they have yet received. Mr. Bennett doubts whether natural selection is adequate to account for the growth of organisms of this description, and believes we must recur to the predarwinian doctrine of "design" in nature.—A. W. B.

Nardosmia palmata.—About four years ago my attention was called, by Prof. Albert Hopkins, to a locality in this town where the *Nardosmia palmata* Hook. is somewhat plentiful. It grows in nearly open ground; only a few large trees and some bushes being near, and in the immediate vicinity of a perennial spring of pure cold water. What are the New England localities of this rare plant?—Sanborn Tenney, *Williams College, Mass.*

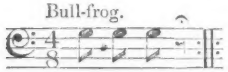
ZOOLOGY.

NOTE OF ICTERUS BALTIMORE. — The following is the spring note of the

Hang-nest.

Sometimes the first part has five notes, instead of four; and the part after the rest is sometimes sung without the preceding part. — S. S. HALDEMAN.

NOTE OF RANA PIPIENS. — The voice of the bullfrog is the vowel of *un*, pronounced like the French nasal *un*, and repeated in groups of three notes: the last one converted into a kind of dipthong, as if by the closing of the organs over the issuing sound. Not having heard the sound for many years, I write from recollection, for which allowance must be made. Popularly, this frog is supposed to say, *Blud-an-ounz!* — S. S. HALDEMAN.

Bull-frog.

DISAPPEARANCE OF THE COLORADO POTATO BEETLE AT NILES, MICHIGAN. — In the May number of the NATURALIST for 1871, I gave a brief account of the Colorado Potato Beetle, as it was observed on the farm of James Hudson during the two previous years. As these beetles have apparently disappeared from that region I have taken pains to learn something of the time of their disappearance. It appears that during the spring of 1871 these beetles were even more plentiful than during the preceding year, and that they attacked the potatoes as soon as they came up and destroyed whole fields, and went on increasing with great rapidity. About the middle of July, however, they began to diminish in number, and by the middle of August, only a few were seen, and by the first of September they had almost entirely disappeared. But the manner or cause of their disappearance is not understood. The fields of late potatoes were mostly saved. Many fields were saved by putting on "Paris green" mixed with fifteen to twenty parts of flour. It was sprinkled over the plants while the dew was on. — SANBORN TENNEY, *Williams College*.

Affinities of the King-crab. — A paper on the Anatomy of the American King-crab (*Limulus polyphemus* Latr.), by Professor Owen, recently occupied two meetings of the Linnæan Society of London. The learned author entered into an elaborate description of the external structure and muscular and nervous systems of the King-crab, and of its habits and modes of life as investigated by Rev. Dr. Lockwood, of New Jersey, and Mr. W. A. Lloyd, at the Aquarium at the Crystal Palace. After a résumé of the views of its structure and affinities entertained by Woodward, Spence, Bate, Packard, Dohrn, Salter, Huxley and other carcinologists, and a reference to the analogies of the Xiphosura with the extinct Trilobites and Eurypteridæ, Professor Owen summed up in favor of retaining the Limulus as a member, though a somewhat aberrant one of the class Crustacea. Prof. Van Beneden, the eminent Belgian embryologist, on the other hand, has published a paper in the "Comptes Rendus de la Société Entomologique de Belge," in which, from a study of the embryological development of Limulus, he arrives at the following conclusions: — 1. That the Limuli are not Crustaceans, as none of the characteristic phases of the development of Crustacea can be distinguished; and that, on the other hand, their development shows the closest resemblance to that of the Scorpions and other Arachnida. 2. That the affinity between the Limuli and Trilobites cannot be doubted; and that the analogy between them is the greater in proportion as we examine them at a less advanced period of their development. 3. That the Trilobites, as well as the Eurypteridæ and Pœcilopoda must be separated from the class Crustacea, and must form, with the Arachnida, a distinct division. — A. W. B.

Respiration of Fishes. — M. Gréhant, in his lectures on respiration, recently delivered at the École Pratique de la Faculté de Medicine of Paris, mentions some interesting facts in relation to the respiration of fishes. He refers to the researches of M.M. Humboldt and Provencal, who found that a tench placed in a small quantity of water (three or four quarts) used nearly the whole of the dissolved oxygen in the course of seventeen hours, whilst a quantity of carbonic acid amounting to about four-fifths of the oxygen removed was exhaled. They found that the whole surface of the body of the tench acted like the gills in removing the oxygen, as the same amount disappeared when the animal was

only so far immersed that its head and gills were free. In one of M. Gréhant's experiments five gold fish removed the whole of the oxygen from a small quantity of water before they were asphyxiated, whilst carbonic acid was exhaled to double the amount of the oxygen absorbed. A small amount of nitrogen appears also to be exhaled. He points out the analogy that obtains between the respiration of fish and of the fœtus in the uterus. — A. W. B.

The Great Northern Shrike and the English Sparrows. — I have lately received with much interest from a pupil in Rutgers College Grammar School, a fine male specimen of the Northern Butcher-bird (*Collyrio borealis* Baird), which he had shot on the 6th inst. in a larch tree, in the city of New Brunswick. It had just made a repast on the brains of an English sparrow. Certainly it had method in its way of doing the thing. The victim was gibbeted by having its head squeezed into the crotch made by the bifurcation of two branches, each about half an inch thick. Thus suspended, the head was broken in at the top, and the brains taken out. This is not the only case that has come to my knowledge of the marauding on sparrows' brains in this place, by the northern shrike. I am of the belief that the birds of prey are waking up to the fact that the cities are affording a rich winter harvest, hence the resort thither of raptorial birds will greatly increase. It was recently said in a journal, that the owls were becoming numerous in Central Park, and were making forays on the English sparrows. Probably, if looked into, it will appear that the diurnal as well as the nocturnal birds of prey are equally on the increase in these places. Moreover, this fact I think is true of all the parks where these sparrows have become naturalized, and unless means are used to prevent, the increase of birds of prey in those parks will be very considerable, especially in the winter. The wonderfully prolific nature of these little birds will furnish rich and abundant provision, even for the Shrike, although with a singular daintiness, it selects the brains.

As to the acclimatization of the English sparrow — the bird is not quite proof against the severity of our winters. About a week ago, a flock of these birds left Jersey City for the mouth of the Bergen Tunnel, a distance of but little more than two miles, where some wheat had been spilled from a freight car. The snow had taken from them their pickings in the city. Not less than thirty

were counted dead in one place on the snow near the tunnel. The little fellows were unable to get back to their boxes in the city and so perished from the cold.— SAMUEL LOCKWOOD.

PECULIAR COLORATION IN FISHES.— A short time since while examining a number of alcoholic specimens of Cyprinoids from Ogden, Utah, collected by Mr. J. A. Allen last September for the Museum of Comparative Zoölogy, I noticed a species of *Richardsonius* distinguished by a bright vermilion spot on the abdomen. The size of the spot varied in different individuals; in some it was quite small, in others it extended from the base of the pectoral fin to the anal opening. Calling Mr. Allen's attention to this fact he informed me, greatly to my surprise, that this color was not present in the living fish when he caught them, but appeared after the fish had been in alcohol a short time. A dissection of one of these fishes showed me that the color was deposited in the areolar layer or derm, and was therefore a true pigmentary color. The only explanation I can offer to account for this peculiar appearance of color is this:—it is well known that during the breeding season fishes frequently take on the most brilliant colors, which disappear when that season is past. Is it not therefore probable that this color may have been one, at least, of the colors assumed by the fish during the reproductive period, and that the alcohol served in some way to bring out the color thus abnormally.

Whatever may have been the cause, the fact that color can so appear in fishes will serve as a caution to ichthyologists when describing species from alcoholic specimens alone, lest they confound abnormal or seasonal colors with those that are permanent.

If any of your readers have observed a similar peculiarity in any other species of fish, I should be glad to learn of it through the pages of your magazine.— RICHARD BLISS, JR.

DURATION OF LIFE OF THE DANUS ARCHIPPUS.— About the middle of last September I found my first larva (*i. e.* the first I ever happened to see though the fly is common even hereabout) and took it home to feed. I afterwards found more, having finally eight pupas, dating from 1st to 13th October, half of which I gave away; of the balance two came out males, but imperfect, the third was a female and I kept it in an empty wardian case hoping the fourth might be a male. I cannot give the date of its appearance but it was about the 18th, and at the end of a week it was

still alive and trying to suck a bit of apple paring. I then offered it some sugar and water on which it fed greedily, but the solution being too strong stuck to its feet and in struggling it lost two of them. On the 30th the last fly came out a female, and then I determined to try how long I could keep her, making my sweetened water very weak. The first mentioned died on the 15th November, and the last on the 10th December being then forty days old, and I think might have lived longer but that in the mean time I had filled up my case with plants and as she persisted in keeping near the glass her wings were continually drenched by the moisture collected on it.—Louis Mitchell, *Norwich.*

American Leeches.—Our fresh water leeches, neglected for so long, have at length received attention from Prof. Verrill, who contributes an illustrated article on them to the "American Journal of Science" for February. About twenty-five species are enumerated, most of them being new to science, one species (*Cystobranchus viridus* Verrill) lives in both fresh and salt water. Most of our common leeches belong to Clepsine, and are found under submerged sticks, etc. and occasionally on the under side of turtles, but they seldom, if ever suck blood. They feed upon insect larvæ, small worms, etc.

GEOLOGY.

A New Cave in Berks County, Pennsylvania, was discovered sometime last November and was explored to some extent in February 1872. The above cave is now explored to the length of about five hundred feet and in width nearly three hundred feet in several apartments composed of limestone and silicious rock. The stalactites and stalagmites are of a beautiful nature, some stalactites are nearly pure silica, some twelve to fourteen inches in length and one and one-half inches in thickness, and in one apartment all quartz crystals, some purple, are as near Amethyst as can be. I intend to explore the whole and expect to find a "*bone cave* below, as the present floor, I am sure, at one time dropped down and is now from twenty to twenty-five feet in depth. I expect to find an entrance to the lower bottom. The temperature of the cave is from sixty to sixty-five degrees F. in some apartments. I think the stalactites are purer and finer than in the Mammoth Cave of Kentucky. The above cave is now

leased by Samuel Kœhler about three miles from the village of Kutztown, who intends to have ready accommodations for visitors and explorers during this April.— H. W. Hollenbush. *Reading, Pennsylvania.*

MICROSCOPY.

An Improved Mode of Observing Capillary Circulation. As I have never seen in print the following method of exhibiting the circulation of the blood in the frog, I send it hoping that it may enable some one interested in such studies to demonstrate the distribution and influence of the nerves upon the capillary vessels and circulation. I have, for over twenty years, been aware of the peculiar manipulation presently to be described; where I first obtained the knowledge, or how, I cannot state. I have made the facts known to a great many microscopists, and have not, as yet, met any one who previously knew it. If we grasp a frog in the hand and plunge it in water about as warm as can be conveniently borne, say about 120°, though I have never measured this, judging simply from the apparent warmth to the hand, we shall find that, in a few moments, the frog will become perfectly rigid; it may now be removed and laid upon a plate for dissection. Carefully opening and stretching the parts by pulling upon the fore limbs gently, or even cutting the bones if necessary, the heart may be displayed, showing the contraction and expansion beautifully; and if now the animal is placed in warm water, the lungs will immediately float out, and by a suitably contrived stage, the circulation may be examined. It is better, however, not to do this but to draw out gently the large intestine by means of blunt forceps, and then spreading the mesentery on the glass of the frog plate (I find it convenient to use a large one with an elevated glass, instead of one in the same plane, on which to spread the mesentery) we can observe the capillary circulation very nicely with a $\frac{1}{4}$ or $\frac{1}{5}$ inch objective, by dropping a bit of thin glass over the place or with a higher power "immersion." Of course the parts opened must be kept moist and covered with a cloth, and a few drops of tepid water added from time to time. If the experiment has been properly conducted, the animal will remain perfectly quiet and the circulation will continue for hours; I cannot say how long, for I have never known it to cease until long after I had finished all the exhibition I have ever had occasion to make.

If the frog is a large one, the mesentery can be spread out so as to afford the most magnificent exhibition of capillary circulation, with a distinctness, and under an amplification which will excite the greatest admiration and astonishment in any one who has only seen it hitherto in the web, or the tongue.

The objectives of a high power ought to be more tapering at the end than our American makers usually furnish them. In this respect, some of the foreign objectives are superior. It would be very little more trouble to make the higher powers at the object end but little larger than the front lens, and thus infinitely more convenient for work than with the large flat surface which most of them now present. In fact, with a $\frac{1}{8}$ or $\frac{1}{12}$ American objective, as ordinarily made, it would be impossible to approach sufficiently near to the mesentery to focus on the smaller capillaries without striking some of the larger bloodvessels. If nothing more could be done, the front set at least might be mounted in a little projecting tip or nose, and if those who are ordering objectives will insist upon this, I doubt not the opticians will do their part.—H. L. Smith.

The New Erecting Arrangement.—In the January number of this Journal, and also in the Monthly Microscopical Journal of the same date, Dr. Ward describes "A new erecting arrangement especially designed for use with Binocular Microscopes." The arrangement proposed by Dr. Ward will undoubtedly work as he proposes, but *cui bono?* It is an axiom in microscopy, as well as in other pursuits, that the simplest means of accomplishing an end is the best. Dr. Ward's arrangement is complicated and troublesome, and unless all the lenses are well made and carefully centred, definition will be injured. Dr. Ward is correct in his observation that the "*erectors usually furnished* [italics are mine] are not good and the use, otherwise satisfactory, of a good objective as an erector has not yet afforded the advantage of binocular vision." The first clause is correct because "the erectors usually furnished" reverse, counteract or destroy all the corrections which the opticians have taken so much pains to introduce into the objectives. The second clause refers to binocular vision. This has been completely accomplished by Tolles' binocular eyepiece which has been in use and before the public more than six years. Without any change from, or addition to, its regular construction or use, it gives an image *erect*, *binocular* and *stereo-*

scopic with any objective, from a four-inch to a $\frac{1}{15}$ inch; and of course it may be used for dissecting by transmitted or reflected light with any objective having "working distance" enough for manipulation — certainly with a half-inch. The only objection, if it is one, against the instrument for this use, is that the "power," the amplification, is necessarily higher than with other binoculars. But where a *very low* power is wanted I believe a pair of spectacles set with magnifying periscopic lenses will prove to be better than any binocular dissecting microscope yet devised. But the objection to the "usual erector" for monocular instruments remains. This was remedied by Tolles years ago; so long ago that he has forgotten when. He made erectors that did not disturb any of the corrections of the objective, but preserved them and gave as good effects as were obtained without an erector.

When will American microscopists learn what has been done in instruments made in their own country, by their own artists? C. S.

Note on the Above Remarks. — It can hardly be necessary to state that Tolles' binocular eye-piece, with which the writer has sometimes worked, was ignored in the paper referred to, simply because there was no occasion to mention it,— it being no novelty but an article whose properties, have been perfectly familiar to American (and foreign) microscopists for years. It is only fair to add that the new arrangement, which can be added to any microscope at a cost of two or three dollars, has been used for months by several microscopists who consider it extremely simple and convenient.

That an erector (or anything else) however perfect, can be added to the objective and ocular and give "as good" optical effects as would be obtained without the additional refracting and dispersing surfaces, is much disputed and surely cannot be considered a conceded point at the present time.

If Mr. Tolles is prepared to supply the market with erectors radically superior to those generally used, microscopists will doubtless learn the fact when it is announced, as I do not find it now, in the catalogue of the Boston Optical Works or in their advertisements in the Naturalist and other journals.— R. H. W.

Oblique Illumination.— A new contrivance, for obtaining oblique transparent illumination with high powers and black

ground illumination with medium powers, was introduced by Col. Horsley of the East Kent Natural History Society. He uses light reflected from the inside of a broad, short, silver-plated tube beneath the object. The tube may be silvered, not very permanently, by rubbing it with a solution of nitrate of silver and hyposulphite of soda. Such a tube, placed in the stage opening, would give a more oblique illumination than could easily be obtained otherwise in instruments having a thick stage.

Glycerine in Microscopy.— Dr. W. M. Ord, of St. Thomas Hospital, London, questions the safety of glycerine as a medium for studying and mounting microscopic objects. Its solvent power over carbonate of lime is well known, and he had found it ruinous to crystals of murexide, oxalate of lime, and triple phosphate. Might it not produce unsuspected molecular changes in other objects? Portions of tissue preserved unaltered in it for years, might have been affected in molecular constitution by it at the first penetration and before the first observation. More light is wanted on this subject.

Practical Histology.— Dr. Wm. Rutherford gives, in the Quarterly Journal of Microscopical Science for January 1872, a synopsis of his course of instruction in Histology. The paper is too long to reprint and too dense for abstract, but it is full of suggestions that will be useful to many others besides medical students. The author has a dashing and not unattractive manner of expressing his dissent from the opinions of most microscopists in England and this country in regard to apparatus, etc.

Variations in Size of Red Blood-corpuscles.— Manassein ("Centralblatt" No. 44, October 28th, 1871) gives the result of more than forty thousand measurements on one hundred and seventy-four different animals, intended to show the effect of various physiological and morbid influences on the size of the red corpuscles. In general, influences which raise the temperature of the body were found to diminish the size of the corpuscles, such as very high temperature of the external medium, or septic poisoning. Excess of carbonic acid in the air also acts in the same way. Oxygen, on the other hand, increases the dimensions of the corpuscles, and so do, in general, all substances which depress the animal temperature, as external cold, quinine, hydrocyanic acid, and intoxicating doses of alcohol. Morphia is an exception, since,

though it generally reduces animal temperature, the corpuscles become larger under its influence. Finally, acute anæmia (produced by arterial hemorrhage) increases the dimensions of the corpuscles.— *Quarterly Journal of Microscopical Science.*

Comparative Size of Red Blood-corpuscles.— Mr. George Gulliver states in the same Journal, that recent measurements confirm his conviction that the size of these corpuscles, in families of fishes and reptiles, bears little relation to the size of the species; while in many families of birds and mammals, there is such relation, the largest corpuscles occurring in the largest species and the smallest corpuscles in the smallest species.

Vitality of Organic Germs at High Temperature.— This standard question of the experimenters in spontaneous generation, is attracting increased attention from its relation to the more fashionable question of disinfection. It is discussed in several numbers of the "Chemical News." Mr. G. E. Davis calls attention to the fact that the ovens, in which fabrics are baked for purposes of disinfection, are often irregularly heated and may vary fifty degrees from the thermometer's indication. Hence, making allowance for this uncertainty, the highest temperature desired cannot be safely attempted, and the temperature attempted may not be gained. He believes that the heat employed has little action upon the disease germs, and rather tends to encourage their growth. He advises that a vessel of carbolic acid diluted with an equal volume of water be placed near the clothing, in order to gain the combined effect of the heat and the phenol vapor.

Mr. Richard Weaver states that 350° Fahr. is the highest temperature available for disinfecting clothing: and Mr. H. B. Yardley queries whether germs might not be destroyed at intermediate temperatures although they would live at certain lower and higher degrees; thus, might not life be destroyed at 330°, which would continue to exist at 200°, 300° and 400°?

"Object Teaching" in Microscopy.— It is customary at the regular fortnightly meetings of the East Kent Natural History Society at Canterbury, England, to make dissections of plants and animals, and microscopical demonstrations of the same. The three following items are derived from the Proceedings of this society.

Size of Blood-discs.— Mr. George Gulliver predicted that

these corpuscles would soon be recognized as of importance in systematic zoology, and demonstrated the relation of their size to the respiratory function. The blood-discs of Amphiuma are the largest now known, supplanting, in this respect, those of the familiar Proteus.

Raphides and Plant-crystals.— Mr. Fullager gave demonstrations of the crystal-prisms of Quillaia bark, and noticed their size, prismatic and angular outline and polarizing properties, as points of distinction from true raphides which are acicular and occur in bundles. The order Iridaceæ abounds in crystal-prisms.

Mr. Gulliver showed the great importance of plant-crystals, especially raphides, in systematic botany; the raphidian character being so eminently natural, and so much more fundamental and general than other single diagnostics. "The shortest and sharpest diagnosis of the Onagraceæ would be Calycifloral Exogens abounding in raphides; of Galiaceæ, Corollifloral Exogens abounding in raphides; of Orchidaceæ, Gynandrous Endogens abounding in raphides; of Hydrocharidaceæ, Hydral Endogens destitute of raphides." Similar examples occur extensively in Mr. Gulliver's Memoirs in the Pop. Sci. Rev., Oct. 1865; Ann. Nat. Hist., 1861–1865; Quart. Jour. Mic. Sci., 1864, 1865, 1866, 1869; Seeman's Jour. Bot., 1864, 1866, 1867 and 1869. The crystal-prisms of Quillaia bark, shown by Mr. Fullager, and of Guaiacum, demonstrated by Col. Horsley, test the genuineness of the officinal barks; for though crystal-prisms abound in many British Endogens and in exotic Exogens they have not yet been observed in native Dicotyledons: and while true raphides are not uncommon in foreign shrubs and trees, they have not yet been demonstrated in any British trees. Sphæraphides were shown by Col. Horsley in the prickly pear (Opuntia) and by Mr. Gulliver in the Caryophyllaceæ. The raphidian character of the British species of Lemna was constrasted with the exraphidian Wolffia. Of the British Euphorbiaceæ, Mercurialis alone abounds in sphæraphides; and the curious starch-sticks are equally characteristic of Euphorbia. By the raphidian diagnosis, the minutest portion of a plant may often be located in its own order as distinguished from all other orders of the same alliance.

Respiration in Abranchiate Worms.— Mr. Gulliver exhibited and described a worm, about a quarter of an inch long, of the

Naid family which abounds in pools near Canterbury. The vivid action of the vibratile cilia within the intestines, causing a rapid current of water, was seen in the pellucid segments of the thin, flat body, and was regarded as a true respiration. The same may be seen in *Sanuris variegata*.

Development of Hydrodictyon.—Mr. Keit, of the Dublin Microscopical Club, obtained, by cultivation, two forms of this plant, an irregular network of large cells, and the ordinary nets which "appeared" to be produced from the irregular form. Further study is promised.

The Maltwood Finder.—This little accessory, used by almost every microscopist, is used under two disadvantages, the want of exact correspondence in position of the scales on different plates, and the size of the squares, in one of which, under a high power, an object may still be lost. Mr. W. K. Bridgman offers, in the "Monthly Microscopical Journal," a means of correcting these difficulties.

Each person using the finder in exchanges, is advised to prepare a common slide with a label in the centre and a dot on this, indicating the position of the centre of the central square of his own Finder. This "test slide," properly named, may be sent to any correspondent as a key to the correction if any, to be made in using *his* Finder.

The position of an object in a square must be recorded, or much of the usefulness of the Finder is lost. Mr. Bridgman indicates this position by a dot having the same relation to the figures. Thus $\frac{2}{2}\frac{5}{5}$ would indicate that the object was situated in the centre of the square $\frac{2}{2}\frac{5}{5}$, or $\frac{2}{2}\frac{5}{5}$. that it was far to the right of the centre. The writer (R. H. W.) has always been accustomed to record the position in the square by decimals; as, in the cases above, $\frac{2}{2}\frac{5\cdot5}{5\cdot5}$ and $\frac{2}{2}\frac{5\cdot9}{5\cdot5}$. This plan, which is convenient, and not liable to mistakes, has been mentioned to many persons, and doubtless used independently by many more, but is not recollected to have been published before. It is accurate to within one-tenth of the diameter of a square, which is quite sufficient in practice; but two places of decimals may be used, if deemed necessary, to indicate positions very near a line, as $\frac{2}{2}\frac{5\cdot01}{5\cdot5}$ or $\frac{2}{2}\frac{5\cdot99}{5\cdot5}$.

NOTES.

PHILADELPHIA.—AMERICAN PHILOSOPHICAL SOCIETY, *December 15th.*—A sum of money was appropriated for the planting and preservation of a grove of oaks in Fairmount Park, to be called the Michaux Grove, in accordance with the will of the botanist Michaux.

Prof. E. D. Cope read a paper "On the *Pythonomorpha* of the cretaceous strata of Kansas." This embraced a synopsis of the species of the order known from all parts of the world, by which it appeared that America was its home, only four species having been described from Europe. He said that the *Danubiosaurus* of Bünzel had no relationship to the group. The American species were forty-two, distributed as follows: New Jersey green-sand, 15; rotten limestone of Alabama, 7; chalk of Kansas, 17; other localities, 3. The Kansas species were referred to *Clidastes* 3 sp., *Edestosaurus* 4 sp., *Holeodus* 4 sp., *Liodon* 6 sp. Of these *Edestosaurus tortor* and *E. stenops*, *Holeodus coryphaeus* and *H. tectulus;* and *Liodon curtirostris*, *L. latispines*, *L. glandiferus*, and *L. crassartus* were described as new.

January 5, 1872.—Hon. Eli K. Price read a paper "On some Phases of Modern Philosophy," in which he combatted the views of the Heterogenists and of the Evolutionists. In the latter part of the subject he opposed the views of Darwin, asserting that the variations seen among domesticated animals had no parallel among those in a state of nature, and the fact of their ready hybridization is indication of their specific unity. He quoted Professor Wyville Thompson, to the effect that no transition from species to species had ever been observed in palæontological history; and asserted that the variations observed among animals on which the developmentalists relied in evidence of their theory, were few and abnormal, and entirely insufficient for the use made of them. That the origin of man from apes was not supported by evidence. Lastly, that the theories of evolution are highly injurious to faith and morals, and thus to Christian civilization.

January 19th.—Benj. Smith Lyman read a paper "On the Oil Bearing Region of the Punjaub," accompanied by a topographical map. He pointed out the Tertiary age of the oil-bearing beds.

Professor Cope read a paper "On a new fossil reptile from the cretaceous strata of Kansas," which was named *Cynocercus incisus*. The vertebral articular faces were deeply excavated above and below, so as to give them a transverse character. A new Crocodilian from the same region was named *Hyposaurus Vebbii*.

Professor H. Hartshorne read a paper on "Organic Physics," of which the following is an abstract:

1. The expression "organic physics" is as well justified as "organic chemistry" and "animal mechanics." For,

2. Vital force is clearly *correlated with other physical forces*, as heat, light, etc.

3. But the correlation is *not identity*.

4. Advocates of the "continuity" theory have endeavored to make it *appear* to be identity; but they will not succeed; because,

5. The effects of heat, light, electricity, magnetism and gravitation are known, and they always tend (in the absence of life) to an opposite kind of change to that which occurs under life-force; namely,

6. They form of C., H., N., S., P., and Cl., compounds of few equivalents and stable equilibrium; while, under life-force, the same elements are made to produce compounds of many atoms or equivalents and of unstable equilibrium; the first are mainly crystalloids, the second always colloids.

7. The directness of this opposition is especially demonstrated by the result of death (arrest of life-force), which is attended by the resolution of the *complex, unstable, colloidal* organic substances into more simple, stable crystalloids and gases.

8. Eliminating all the functions of living beings otherwise explicable, we must restrict the term "vital action," or "action of life-force," to the *conversion of inorganic into organic material*, with type-formation or organic construction as its result. It is *supposable*, at least, though not proven, that the assumption of particular forms, under given circumstances, is (analogous to crystallization) the *property* of the *bioplasm; i.e.*, given the matter, the form results as its property or attribute.

9. But chemists have *never succeeded in making organizable matter by synthesis*. Nor is it *likely* that they ever will. All complex organic substances made in the laboratory (as *urea* by Wöhler, fatty acids, etc., by Berthelot, and even, if made, crystallizable neurin) are *post-organic* (a term first used by the author); *i.e.*, results of the downward or retrograde metamorphosis; produced not by life-force as such, but by the composition or balance between life-force and the other forces; they are not germinal or formative, but *formed* and *effete* materials (Beale's terms).

10. The question of the possibility of *abiogenesis* is not yet *finally* decided. Crosse gave it momentum with his galvanized

œarus; Pouchet and Pasteur have long debated it; Owen, Bennett, Clark, and a few others have of late years reasserted it; Bastian (Nature, 1870) makes an elaborate experimental defense of it. We note concerning it as follows: (*a*) The manipulation (to avoid *introducing* minute viable forms) requires an almost or quite *impracticable* delicacy throughout. (*b*) When heat is used we have always the alternative of concluding that certain minute organisms, *germs or spores*, can resist a higher temperature than was supposed, *or* that, taking for granted that the heat employed must have killed all germs, new life afterwards sprang up without parentage. All experience makes the former much more probable. George Pouchet's experiments with rotifers tend this way. Jeffries Wyman found that, although four hours boiling would not, five hours would put an end to all manifestations of life. Frankland's experiments (and Calvert's) gave similar results against abiagenesis. (*c*) Supposing (although Huxley does not) that Bastian could not have mistaken "Brownian" molecular movements for evidence of life, we yet observe that, *if* life sprang up in Bastian's apparatus, it was *such life as can exist without air or oxygen;* altogether unlike, therefore, ordinary world-life. (*d*) The assertion of Pasteur is justified, that the *onus probandi* lies with abiagenesists, since there is *no experience* of any living form *more* than $\frac{1}{1000}$ of an inch in diameter springing into life out of inorganic matter; it is, therefore, vastly *improbable* (needing most cogent evidence to prove) that any form *less* than $\frac{1}{1000}$ of an inch in size can be made to spring into life from inorganic matter.

11. While abiagenesis is *unproved*, we hold to the conclusion that vital force is *not* the mere outcome or resultant of any or all of the other cosmic forces.

12. How does it differ? Of the organic cell or "physiological unit," the most constant determinable acts or changes are *incretion and excretion;* atomic or molecular *motion*, definite in *results*, is an essential of life. Must *not the motion itself be peculiar?*

13. More definitely, we find,—that, while in the condensation of matter in the (nebular theoretical) formation of the Sun and planets, there was *integration of matter with dissipation of force as heat* (H. Spencer), life-action involves *integration of matter with accumulation of force* (*stored up* physical force in the plant of Barker; "bottled sunshine," of some one else). This is a striking contrast.

14. *Sexual* union is closely analogous to *chemical* union; instead of combustion, it makes construction by detaining products.

15. Again we notice the analogy between the spiral phyllotaxis of plants (opposite leaves a double spiral, whorls two or more, and bilateral symmetry of vertebrates and articulates and some mollusks, and radial symmetry of radiates and cœlenterates corresponding) and the spiral helix of the electro-magnet. As the

opposite chemical and polar elements of the battery are to the current of the helix, so (may be) are the polarities of the sperm-cell and germ-cell to the spiral phyllotaxis of plants and symmetrical (usually double) organo-taxis (a new term) of animals.

16. A *close* (but *reversed*) analogy exists between heat-force and vital force. A spark of fire may "light" and so burn successively an indefinite amount of *combustible* matter. A spark of life may *animate* an indefinite amount, successively of *organizable* matter. The former, combustion, *reduces* complex substances, which are unstable, to *more stable* compounds. The latter, life, *elevates* similar substances to more complex states; but with constant transmutation of their forms.

17. Such analogies are as yet crude, and do not solve the mystery of life.

18. But the facts on which they rest justify and encourage the *physical investigation* of *vital actions;* including their study *under physics; organic physics.*

19. Such a view of life is in no manner antagonistic of theism or of "teleology," any more than is the now familiar reduction of digestion, circulation, absorption, etc., to the category of chemical or physical phenomena. All such analytical inquiries are, moreover, *legitimate*, so long as they are accurate; *whether they point to biogenesis or abiogenesis; to the origin of types by interrupted appearances or by evolution.*

February 2d.—Prof. Geo. B. Wood communicated further results of his experiments with salts of potassa on vegetation, and especially on grain and fruits:

He stated that in a field of grain in which the soil had been previously exhausted by bad culture, one-half was enriched by barn manure, the other with the same with wood ashes added. The effects of the latter were especially marked, and much greater than with the former. The most striking results were obtained by the use of the ashes of the poke, *Phytolacca decandra.*

Prof. Cope read a paper on the "Families of Fossil Fishes of the Cretaceous strata of Kansas."—

The greater part of these were shown to be Physostomous Actinopteri of three families, viz.: the *Saurodontidæ*, the *Pachyrhizodontidæ*, and the *Stratodontidæ*. Of the first, four genera and ten species were described, some of them (*Portheus sp.*) among the most formidable of marine fishes. The peculiarities of the succession of teeth in *Portheus* and *Saurocephalus*, respectively, were pointed out. Of *Pachyrhizodontidæ* two genera (*Empo* and *Pachyrhizodus*) and five species were described, and of *Stratodontidæ*, three genera and seven species. *Stratodus* was a form provided with multitudes of minute shovel-headed teeth. As a general result the great resemblance of this fauna

to that of the English Chalk, was pointed out, six of the nine genera of Kansas having been found in the latter.

March 1*st.*—Benjamin Smith Lyman read a paper "On the Topography of the Punjaub Oil Region."

It aimed at a somewhat detailed account of the topography of the oil region; its situation, general features, special features, etc. The different places were mentioned where each kind of topography is to be seen, and its causes and simple laws pointed out; chiefly in order to show the great usefulness of careful topographical studies to geology. A short sketch of the geology of the region, aside from structure, was also added.

The general section of the rocks of the region is as follows, below the new and old alluvians:

Miocene (Sivalik) perhaps	3,000 feet
Eocene (Nummulitic), with oil, ...	1,950 "
Carboniferous, without oil, about	1,800 "
Devonian, with Saltana plaster, ...	2,850 "
	9,600 feet

The oil or asphalt (dried oil) or rock tar (melted asphalt) is found at a dozen different places, and in very small traces at half a dozen more, all within a space of a hundred miles square. They are all in Nummulitic rocks, except one in carboniferous. The deposits all seem of very small horizontal extent, sometimes only a few feet, seldom a hundred yards, once only as much as half a mile. In this case, too, the oil-bearing bed is a hundred feet thick, in one other forty, in two others twenty, and in the rest much less. The oil comes in some places from lime rocks, in others from sand rock or shale. The yield of one well was at first fifty gallons a day, but grew quickly less, like the ordinate of a parabola, and seems likely to reach 3,000 gallons in all within a year and a half. At a rough guess a hundred such wells might be bored in the region, with a whole yield, then, of hardly 7,000 barrels. The natural springs (five) yield from a gill to three quarts a day. The oil is dark green and very heavy (25 B. or less). There is nothing whatever in the Punjaub oil deposits to bear out a belief in the distillation of oil from one bed to another, or in its emanation from below or in its gradual passage from the lower parts of a bed to higher parts of the same bed, or in its origin from any source but the decomposition of organic matter in the rock. Neither is there anything here (or anywhere else) to justify wild hopes of finding large quantities of oil by boring into cavities below the oil-bearing bed. The occurrence of salt, gypsum and alum shales in large quantities is noticed; as well as that of sulphur, saltpetre, brown coal in small quantities; and that of traces of copper, iron and lead.

Prof. E. D. Cope read a paper "On *Buthmodon*," a genus of extinct Ungulates. It was represented as perissodactyl in general

characters, but with peculiarities of dentition of a combined ruminant and suilline character. There was on the outer side of the molars but one crescent, and before this a tubercle. The inner portion of the crown a tedge. Besides the species *Bathmodon radians*, a second form, *Loxolophodon semicinctus*, was referred to the group. The former animal was large as the rhinoceros, the second equal to the tapir.

Prof. Cope read a paper "On two new species of *Ornithosaurians* from the Kansas cretaceous." They were described as *Ornithochirus umbrosus* and *O. harpyia*. The former was regarded as one of the most gigantic of the Pterodactyles, extending probably 25 feet from tip to tip of the wings. The other was two-thirds the size.

Prof. Cope read a paper "On *Protostega*," a genus of extinct Testudinata. A detailed account of the osteology of *P. gigas* from the cretaceous was given, by which it appeared that the genus had separate ribs as in *Sphargis*, and that the carapace was formed by large radiating plates of bone in the skin. Two other species were described — *P. tuberosus* and *P. neptunus*. The latter, the largest known marine turtle, from New Jersey; the former, from the cretaceous of Mississippi, had been referred by Leidy to the Mosasauroids.

A discussion on Mr. Price's paper read at the last meeting took place, in which Prof. Hartshorne, Prof. Lesley, Mr. Price and Prof. Cope took part. Prof. Hartshorne supported the opposition to Abiogenesis expressed in the paper, on the ground of insufficiency of evidence in its favor, but believed in the evolution of species. Prof. Lesley objected to the insufficiency of Mr. Price's reasoning against the labors of experts in biological science, and stated that the more attention he paid to the subject, the better satisfied he became that man was descended from apes. Prof. Cope stated that Mr. Price's paper was in error as to the facts:

(1) That variability of specific type was even more common in nature than under domestication; examples from many so called "protean" genera being cited. (2) That some wild species did produce fertile hybrids. (3) That transitions between species both at the present time and in past geological periods, were common, but were concealed by a universal *petitio principii* involved in the practice of naturalists. This consisted in uniting distinct forms or species under the head of one species, as soon as the intervening connections were found. (4) That the known cases of

transition were numerous, not few; and that common induction required that we should believe of the unknown, that which we see in the known, when other circumstances were identical.

At the annual meeting of the London Geological Society, February 16, Mr. Joseph Prestwich, F.R.S., President, in the chair, the Wollaston Gold Medal was presented to the Secretary, Mr. David Forbes, for transmission to Professor Dana, of Yale College, Connecticut. The President said:

"I have the pleasure to announce that the Wollaston Medal has been conferred on Prof. Dana, of Yale College, New Haven, U. S.; and in handing it to you for transmission to our Foreign Member, I beg to express the great gratification it affords me that the award of the Council has fallen on so distinguished and veteran a geologist. Prof. Dana's works have a world-wide reputation. Few branches of geology but have received his attention. An able naturalist and a skilful mineralogist, he has studied our science with advantages of which few of us can boast. His contributions to our science embrace cosmical questions of primary importance—palæontological questions of special interest—recent phenomena in their bearings on geology, and mineralogical investigations, so essential to the right study of rocks, especially of volcanic phenomena. The wide range of knowledge he brought to bear in the production of his excellent treatise on Geology, one of the best of our class books, embracing the elements as well as the principles of geology. His treatise on Mineralogy exhibits a like skill in arrangement and knowledge in selection. In conveying to Prof. Dana this testimonial of the high estimation in which we hold his researches, may I beg also that it may be accompanied by an expression how strongly we feel that the bonds of friendship and brotherhood are connected amongst all civilised nations of the world by the one common, the one universal, and the one kindred pursuit of truth in the various branches of science."—Mr. David Forbes, in reply, said that "it was to him a great pleasure to have, in the name of Prof. Dana, to return thanks to the society for their highest honor, and for this mark of the appreciation in which his labors are held in England. It had rarely if ever occurred in the history of the society that the Wollaston medal had been awarded to any geologist who had made himself so well known in such widely different departments of the science, for not only was Prof. Dana pre-eminent as a mineralogist, but his numerous memoirs on the Crustaceans, Zoophytes, coral islands, volcanic formations, and other allied subjects, as well as his admirable treatise on general Geology, fully testify to the extensive range and great depth of his scientific researches."

The President then presented the balance of the proceeds of

the Wollaston donation fund to Prof. Ramsey, for transmission to Mr. James Croll, and addressed him as follows:

"The Wollaston fund has been awarded to Mr. James Croll, of Edinburgh, for his many valuable researches on the Glacial phenomena of Scotland, and to aid in the prosecution of the same. Mr. Croll is also well known to all of us by his investigations of oceanic currents and their bearings on geological questions and of many questions of great theoretical interest connected with some of the great problems in Geology. Will you, Prof. Ramsey, in handing this token of the interest with which we follow his researches, inform Mr. Croll of the additional value his labors have in our estimation, from the difficulties under which they have been pursued, and the limited time and opportunities he has had at his command." — Prof. Ramsey thanked the president and council in the name of Mr. Croll for the honor bestowed on him. He remarked that "Mr. Croll's merits as an original thinker are of a very high kind, and that he is all the more deserving of this honor from the circumstance that he has risen to have a well recognised place among men of science without any of the advantages of early scientific training; and the position he now occupies has been won by his own unassisted exertions.—*Nature*.

California Academy of Sciences. *March 4th*. A Communication was received from Prof. George Davidson, at present in the East, accepting the Presidency of the Academy.

A translation by Dr. A. B. Stout of an interesting paper by G. V. Frauenfeld, K. V. (of Vienna, 1870) on the "Extinct and Perishing Animals of the Earliest Epochs of the World" was read by the Secretary.

Dr. Ellinwood read a digest of a translation of the proceedings of the Society of Natural Sciences of Neuchatel, 1869–1870, giving a brief résumé of the principal discussions which occurred at the Archæological Congress at Copenhagen in 1869, being an interesting narration of the developments of antiquity, arising from an investigation of the shell mounds.

Mr. Stearns gave the result of his examination and researches in some of the numerous shell heaps and mounds at Point Penallis, Tampa Bay, Florida, near the supposed landing place of the Expedition of De Soto:—

The latter were composed of alternate thick strata of shells and thin strata of ashes; these alternations were owing to the infrequent visits of the Indians to the localities where these shell heaps are found, and during the interim between these visits a growth of grass and other vegetation had taken place, covering

the heap, which was burnt over at a subsequent visit and a thin layer of ashes was thus made and covered with shells; and this process being repeated, in the course of years, the shell heap when cut through and examined presented the appearance of a regular stratification. The shells found in these heaps are the same as many now found living in the adjacent waters. In the shell heaps and near them, as well as in the burial or earth mounds, fragments of pottery, and arrowheads of chalcedony, and other implements of stone and shell may be found; and near the Point Pinallis mounds a remarkable vase of steatite, shaped somewhat like an ordinary soup tureen, had been discovered. The material of which this vase is made was probably obtained by the Indians at Apalachicola, near which place a deposit of soapstone existed, and the material for the arrowheads was without doubt obtained at the elevated and now fossilized coral reef in Hillsborough Bay, known as Ballast Point, not far from the town of Tampa. Mr. Stearns also briefly referred to the statements of the narrator of the De Soto Expedition relative to the abundance of pearls which were seen in possession of the Indians, and which were said to be obtained by some of the soldiers of De Soto. He was of the opinion that what De Soto's men thought were pearls, were the shells of *Marginella conoidalis*. A great number of this shell had been found in an ancient mound in the city of St. Louis.

Dr. Gibbons presented a copy of the "Oriental Medical Gazette" of Constantinople, which contained a paper by Dr. Abdullah Bey, descriptive of the contents of the mounds in Europe, Asia and Africa; the writer advancing the theory that the mound works being similar all over the world, they should be attributed in their origin to one race.

Mr. Wetmore referred to some interesting developments made in the shell mounds of South America.

Prof. H. G. Hanks presented remarkably fine specimens of jasper and tourmaline from Calaveras County.

"CENTRAL PARK MUSEUM.—*Destruction of Mr. Hawkins' Restorations.*— A TIMES reporter called yesterday on Mr. B. WATERHOUSE HAWKINS in order to ascertain the truth of the allegations made in a communication which appeared in yesterday's TIMES in reference to the destruction of his restorations in the Central Park Museum. Mr. HAWKINS stated that all he had done during twenty-one months to restore the skeletons of the extinct animals of America (of the Hadrosaurus, and the other gigantic animal, which was thirty-nine feet long), was destroyed by order of Mr. HENRY HILTON, on the 3d of May last, with sledge-hammer, and carted away to Mount St. Vincent where the remains were buried several feet below the surface. The preparatory sketches of other

animals, including a mammoth and a mastodon and the moulds and sketch models were destroyed. Mr. HILTON did this, said Mr. HAWKINS, out of ignorance, just as he had a coat of white paint put on the skeleton of a whale which Mr. PETER COOPER had presented to the Museum, and just as he had a bronze statue painted white. Mr. HILTON told the celebrated naturalist who had come from England to undertake the work that he should not bother himself with "dead animals," that there was plenty to do among the living. This illustrates the policy of having such men as HILTON at the head of one of the most important Departments of the City Government. When the skeletons were dug up again, by order of Col. STEBBINS, they were found broken in thousands of pieces. Prof. Henry, of the Smithsonian Institution when he heard of this piece of barbarism, would not believe it. "Why," he exclaimed, "I would have paid them a good price for it." Mr. HILTON however, preferred to destroy the work of the naturalist which had cost the City at least twelve thousand dollars."

We copy the above from a slip cut by a friend from the "New York Times." What good will ever come to science from the million of dollars it is proposed to spend on the new building for a Museum of Natural History in the Central Park so long as the citizens of New York allow vandals and ignoramuses to hold the places that should be filled by men of culture and unquestionable scientific standing?

"WE alluded some time since to the threatened destruction of one of the most notable megalithic monuments in this country, the Great Circle at Avebury, in Wiltshire. All archæologists will be glad to hear that Sir John Lubbock has added one more to his eminent services to science by the purchase of the site on which the Circle stands. It is right also that the meed of praise should be awarded to those of the residents in the district whose zeal has been directed towards the attainment of this object, and who have thus shown their sense of the value of the monument which is one of the glories of their county. We refer especially to the Rev. Bryan King, the vicar of the parish, Mr. Kemm, Mr. George Brown, and the Rev. Alfred Charles Smith, Hon. Secretary of the Wiltshire Archæological and Natural History Society. It is to be hoped that their example will stimulate similar zeal for the preservation of monuments in other parts of the country." — *Nature*.

WHEN will Sir John Lubbock's example be followed here? Every year *our* monuments of a former race are being destroyed and no hand has yet been raised to save them.

PROF. Raphael Pumpelly *has* been appointed State Geologist of Missouri, as we are assured by a correspondent.

A FRENCH Association for the Advancement of Science, has been started. The annual meetings will be held in the various towns and cities. Over 100,000 francs, in shares of 200 francs each, have already been subscribed by the *founders* of the Association.

THE Smithsonian Institution has recently succeeded in obtaining two complete skeletons of the remarkable tapir of the highlands of the United States of Colombia, known to naturalists as *Tapirus pinchaque* or *Roulini*. Previously only the skull had been obtained by Roulin, by whom it was first made known, and it was one of the rarities of the great anatomical collection at Paris. The Smithsonian Institution had before obtained a number of skulls and a skeleton of the still more remarkable tapir of Panama, which had remained undistinguished from the common species of Panama till within a few years, when first described, under the name of *Elasmognathus Bairdii*, by Prof. Gill, from two skulls in the Smithsonian collection. There are no external or dental differences between the tapirs corresponding with the marked differences in the skulls; the external differences being confined to the contour of the forehead, the color, and the character of the hair.

ANSWERS TO CORRESPONDENTS.

SENSITIVE OAT.—The sensitive or animated oat, as it is usually called, is the fruit of *Avena sterilis* L. It is a native of the Barbary States and the region of Gibraltar, but as it is not unfrequently cultivated as a curiosity it has become sparingly introduced in many places. Although not often found in gardens in this region, there will be no difficulty in getting seed from any of the larger dealers or florists.—W. G. F.

BOOKS RECEIVED.

Zoological Record for 1870; being vol. 7 of the Record of Zoological Literature. Edited by Alfred Newton. 8vo, pp. 523, cloth. London. Zoological Record Association. 1871.

Handbook of British Fungi, with full Descriptions of all the Species and Illustrations of the Genera. By M. C. Cooke. 2 vols., 8vo, pp. 981. 407 woodcuts and a colored plate, cloth. London and New York. Macmillan & Co. 1871.

The Metric System of Weights and Measures; an Address delivered before the Convocation of the University of the State of New York, at Albany, Aug. 1, 1871. By Frederick A. P. Barnard. Revised edition, printed by order of the Board of Trustees of Columbia College. 8vo, pp. 194. cloth. 1872.

Geological Survey of Ohio. Report of Progress in 1870. By J. S. Newberry, Chief Geologist. Including reports by E. B. Andrews, Edward Orton, J. H. Klippart, Assistant Geologists; T. G. Wormley, Chemist; G. K. Gilbert, M. C. Read, Henry Newton, W. B. Potter, Local Assistants. Columbus. State Document. 8vo, cloth, pp. 568, cuts with map packet. 1871.

Second Report of the Geological Survey of Indiana, made during the year 1870. By E. T. Cox, State Geologist, assisted by John Collett and G. M. Levette. 8vo, cloth, pp. 594, plates, cuts and maps. Also contains "Manual of the Botany of Jefferson Co.," by A. H. Young.

Sketch of the Botany of Pennsylvania. By Thomas C. Porter. (From Walling and Gray's New Topographical Atlas of Penn.) Folio. pp. 2, and map. 1872.

Notes on Podisoma. By M. C. Cooke. 8vo, pp. 14. 2 plates. London. 1871.

On Nucleated Sporidia. By M. C. Cooke. 8vo, pp. 4. London. 1871.

A FRENCH Association for the Advancement of Science, has been started. The annual meetings will be held in the various towns and cities. Over 100,000 francs, in shares of 200 francs each, have already been subscribed by the *founders* of the Association.

THE Smithsonian Institution has recently succeeded in obtaining two complete skeletons of the remarkable tapir of the highlands of the United States of Colombia, known to naturalists as *Tapirus pinchaque* or *Roulini*. Previously only the skull had been obtained by Roulin, by whom it was first made known, and it was one of the rarities of the great anatomical collection at Paris. The Smithsonian Institution had before obtained a number of skulls and a skeleton of the still more remarkable tapir of Panama, which had remained undistinguished from the common species of Panama till within a few years, when first described, under the name of *Elasmognathus Bairdii*, by Prof. Gill, from two skulls in the Smithsonian collection. There are no external or dental differences between the tapirs corresponding with the marked differences in the skulls; the external differences being confined to the contour of the forehead, the color, and the character of the hair.

ANSWERS TO CORRESPONDENTS.

SENSITIVE OAT.—The sensitive or animated oat, as it is usually called, is the fruit of *Arena sterilis* L. It is a native of the Barbary States and the region of Gibraltar, but as it is not unfrequently cultivated as a curiosity it has become sparingly introduced in many places. Although not often found in gardens in this region, there will be no difficulty in getting seed from any of the larger dealers or florists.—W. G. F.

BOOKS RECEIVED.

Zoological Record for 1870; being vol. 7 of the Record of Zoological Literature. Edited by Alfred Newton. 8vo, pp 523, cloth. London. Zoological Record Association. 1871.

Handbook of British Fungi, with full Descriptions of all the Species and Illustrations of the Genera. By M. C. Cooke. 2 vols., 8vo, pp. 981. 407 woodcuts and a colored plate, cloth. London and New York. Macmillan & Co. 1871.

The Metric System of Weights and Measures; an Address delivered before the Convocation of the University of the State of New York, at Albany, Aug. 1, 1871. By Frederick A. P. Barnard. Revised edition, printed by order of the Board of Trustees of Columbia College. 8vo, pp. 194. cloth. 1872.

Geological Survey of Ohio. Report of Progress in 1870. By J. S. Newberry, Chief Geologist. Including reports by E. B. Andrews, Edward Orton, J. H. Klippart, Assistant Geologists; T. G. Wormley, Chemist; G. K. Gilbert, M. C. Read, Henry Newton, W. B. Potter, Local Assistants. Columbus. State Document. 8vo, cloth, pp. 568, cuts with map packet. 1871.

Second Report of the Geological Survey of Indiana, made during the year 1870. By E. T. Cox, State Geologist, assisted by John Collett and G. M. Levette. 8vo, cloth, pp. 504, plates, cuts and maps. Also contains "Manual of the Botany of Jefferson Co.," by A. H. Young.

Sketch of the Botany of Pennsylvania. By Thomas C. Porter. (From Walling and Gray's New Topographical Atlas of Penn.) Folio. pp. 2, and map. 1872.

Notes on Podisoma. By M. C. Cooke. 8vo, pp. 14. 2 plates. London. 1871.

On Nucleated Sporidia. By M. C. Cooke. 8vo, pp. 4. London. 1871.